MODEL

129

PULSE GENERATOR

INSTRUCTION MANUAL

datron

EHE INSTRUMENTS

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October 1986

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MODEL 129

SECTION I

SPECIFICATIONS

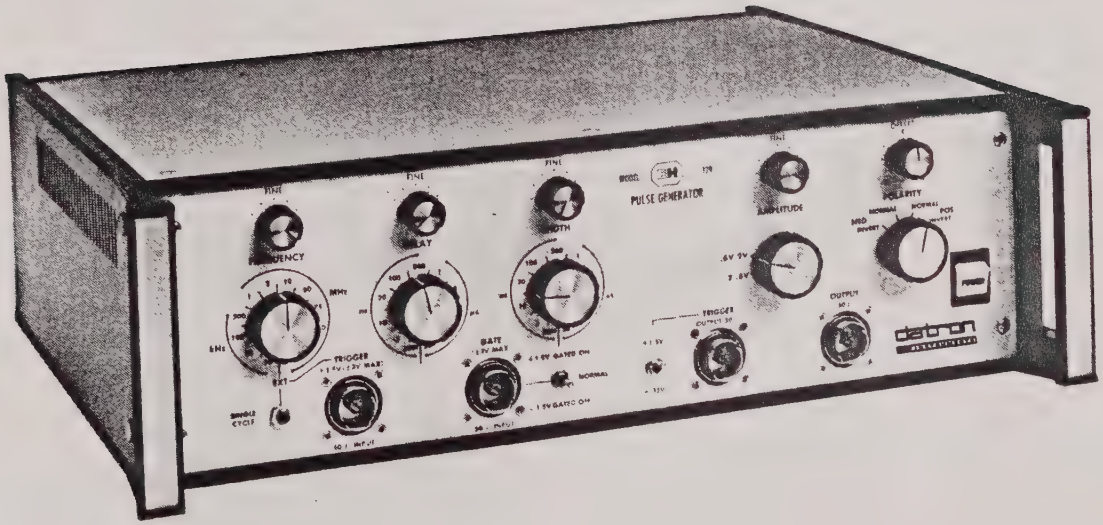

Figure 1-1 Model 129 Pulse Generator

SECTION 1
SPECIFICATION

1-1 INTRODUCTION

The purpose of this manual is to provide basic information for operation of the EH Model 129 Pulse Generator.

This manual includes such essential information as performance specifications, description of controls, list of replacement parts, and schematic drawings.

Section 1 of this manual contains the electrical and mechanical specifications for the instrument. Section 2 contains a description of controls. Section 3 contains an electrical description of the circuitry. Section 4 gives maintenance notes and alignment procedures. Section 5 contains the parts list and ordering information. Engineering schematics are included in Section 6 at the back of the manual.

1-2 GENERAL INFORMATION

The EH Model 129 is a solid-state pulse generator that provides fast risetime and falltime pulses at high repetition rates. Pulse repetition frequency is variable from 10 KHz to 500 MHz - with variable pulse width, delay and output levels. Output pulse risetime and falltime is 500ps or less.

Duty factor capability is 50%; also, output pulse waveforms may be inverted to provide an equivalent duty factor approaching 100% except at the highest pulse repetition rates where minimum pulse width limits the equivalent duty factor. The baseline offset control allows the pulse train to be adjusted off the zero reference up to 1 volt in either polarity.

A separate trigger output provides signals for triggering oscilloscopes, additional pulse generators or other test instruments. The Model 129 may be externally triggered by the single-cycle push-button, or by another pulse generator, at any repetition rate up to 250MHz. The output pulse train can be gated by an externally supplied pulse.

The output of the Model 129 is a current source designed to work into 50 ohms. It may safely drive any lower impedance, including a short-circuit, but should not be left open-circuited unless the amplitude is set to minimum and the base-line offset is set to maximum negative offset.

1-3 SPECIFICATIONS

Pulse Repetition Frequency ..... 10KHz to 500MHz in 11 ranges, with fine control.

Output Pulse Amplitude ..... $\pm$200mv to $\pm$2v into 50 ohms Amplitude continuously variable by 2-position coarse range switch and fine amplitude control.

Waveform Distortion ..... less than 7% P-P at 2v, either polarity.

Rise and Fall Times ..... less than 500ps

Pulse Width ..... approximately 1ns to 50us continuously variable by 10-position coarse range selector and fine control.

Pulse Delay ..... approximately 1ns to 50us continuously variable by 10-position coarse range selector and fine control.

Duty Factor ..... 50% maximum.

Baseline Offset ..... -1v to +1v into 50 ohms, unaffected by pulse amplitude setting, continuously variable by fine control.

Output Terminating Impedance ..... 50 ohms.

External Trigger Input ..... +1.5v into 50 ohms.

External Gate ..... synchronous gate, 3-position switch selects gated on (+1.5v into 50 ohms), normal (ungated), or gated off (-1.5v into 50 ohms).

Trigger Output ..... +0.15v or +1.5v into 50 ohms switch selected.

Trigger Width ..... equal to 50% pulse period for all frequencies.

Single Cycle Operation ..... one output cycle when frequency switch set to external and front-panel pushbutton pushed.

Signal Connectors .... General Radio Type 874.

Power Requirements ..... 105-125 and 200-234 Vac, 50-60 Hz, 83 V-A.

Dimensions ..... 5-7/8in. (14.9cm) high
..... 17-3/4in. (45 cm) wide
..... 13in. (33cm) deep

Weight ..... 25 lbs. (11.4 kg)

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SECTION II

OPERATING INFORMATION

SECTION 2
OPERATING INFORMATION

2-1 USING THE MODEL 129

With a risetime of less than 500 ps, the Model 129 output pulse contains frequency components over 2 GHz. If any of the connectors, cables or attenuators used do not have flat response in excess of 2 GHz, degradation of pulse risetime will occur. Mismatch effects can also degrade the pulse slope (e.g., distortion, ringing, overshoot, etc).

Terminate the Model 129 in 50 ohms whenever possible. If the input impedance of the device or system under test is other than 50 ohms, use an impedance matching device to minimize mismatch effects. Since the deterioration of pulse risetime, due to the pulse passing through a coaxial cable, is proportional to the square of the cable length, use only a few feet of high quality cable whenever possible.

2-2 OPERATING FUNCTIONS

a. **FREQUENCY.** Selects pulse repetition frequency as determined from the internal clock or the external trigger pulse. Range extends from 10 kHz to 500 MHz in 11 ranges: 10/30/100/300 kHz; 1/3/10/30/75/150/300/500/ MHz. External from zero to 250 MHz.

b. **FINE (FREQUENCY)** Continuously variable in each range with overlap to adjacent ranges.

c. **DELAY** Selects time between trigger output and pulse output in ten ranges from approximately 1 ns to 50 μs. A fixed delay of 6 ns is added to the minimum setting on each range. Ranges are min/3/10/30/100/300 ns; 1/3/10/30/50 μs.

d. **FINE (DELAY)** Continuously variable in each range with overlap to adjacent ranges. When the frequency switch is set to either of the two highest ranges, this control is disabled.

e. **WIDTH** Selects the output pulse width from a range of 1 ns to 50 μs. Ranges are min/3/10/30/100/300 ns; 1/3/10/30/50 μs.

f. **FINE (WIDTH)** Continuously variable in each range with overlap to adjacent ranges.

g. **AMPLITUDE** Selects output pulse amplitude in two ranges, 0.2 to 0.6 V and 0.6 to 2 V into 50 ohms.

h. **FINE (AMPLITUDE)** Continuously variable in each range with overlap between ranges.

i. **POLARITY** Selects output pulse to be either positive or negative, normal or inverted.

j. **OFFSET** Continuous baseline offset adjustment of output pulse between - 1 V to + 1 V into 50 ohms regardless of polarity or amplitude settings.

k. **POWER** Controls primary power to instrument rear-panel 1-ampere slow-blow fuses are provided for 117 V 60 Hz operation.

l. **TRIGGER** Provides a positive 1.5 V or 0.15 V (selectable by + 1.5 V ———+ 0.15 V) pulse into 50 ohms. Pulse width is nominally 50% of the clock period except when using an external clock in which case it is approximately the same width as the external clock signal. The switch should be left in the + 0.15 V position when the trigger is not terminated in 50 ohms.

m. **GATE** In conjunction with the switch, (marked + 1.5 V GATED ON, NORMAL, - 1.5 V GATED OFF) allows the output pulse train to be gated on or off by an appropriate external signal. Input impedance is 50 ohms. Maximum allowable signal is ± 3 V. Risetime of the input signal should be 100 ns or faster. When the switch is in the + 1.5 V GATED ON position the output pulse train is inhibited until a + 1.5 V signal is applied to the gate input. At this time the output pulse train will begin and last for a time equal to the width of the applied signal. When the switch is in the center (normal) position the output pulse train is unaffected by the applied gate signal. Placing the switch in the - 1.5 V GATED OFF causes the output pulse train to be inhibited only for the length of time that a - 1.5 V signal is applied to the gate input.

The Model 129 allows the last pulse in a gated burst to be longer than the rest if desired. This may be accomplished by setting the width controls to exceed 50% duty cycle. In this situation all pulses but the last will be automatically limited in width but the last pulse will be determined by width control settings.

n. **EXTERNAL TRIGGER** When the FREQUENCY switch is in the EXT position an external clock signal may be applied to the + 1.5 V TRIGGER connector. Requirements are + 1.5 V into 50 ohms, ± 3 V maximum, risetime 100 ns or faster. When the frequency switch is set to any other position, this input may be used to gate off the pulse train by applying - 1.5 V.

o. **SINGLE CYCLE** Single output pulse occurs when the FREQUENCY switch is in the EXT and SINGLE CYCLE push-button is pushed and released.

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SECTION III

THEORY OF OPERATION

SECTION 3
THEORY OF OPERATION

3-1 GENERAL INFORMATION

This section of the manual contains an electrical description of the circuitry in the Model 129 Pulse Generator. A schematic master is included in the drawing section, showing the overall relationship of the various circuits. The schematic circuit numbers are used to identify components in the circuit descriptions. Refer to the specific schematics in the drawing section to supplement the following discussion.

3-2 BLOCK DIAGRAM

a. Clock Multivibrator.
The clock multivibrator initiates each cycle of the output pulse train in all modes except external drive. The operation of the clock is dependent on the position of the FREQUENCY switch, and on the voltage applied to the gate input. There are four modes of operation of the clock.

(1) Free-running.
When the FREQUENCY switch is in any position except external and the GATE switch is in the normal position, the clock is a free-running multivibrator. The FREQUENCY control selects a frequency range between 100KHz and 500 MHz. The FINE frequency control provides continuous adjustments over the selected frequency range and overlap into the two adjacent ranges.

(2) Gated Operation.
The clock may be enabled or disabled by an externally applied voltage at the gate input connector. When the GATE switch is in the GATED ON position, a +1.5V signal will gate the clock on; with the switch in the GATED OFF position, a -1.5V will gate the clock off. This mode of operation will produce pulse bursts synchronized with the gating waveform. When the GATE switch is in the normal position, the clock is free-running at the frequency determined by the FREQUENCY range control and the FINE frequency control.

(3) External Drive Operation (T0 250 MHZ).
When the FREQUENCY control is in the external position, the clock multivibrator is disabled. The external drive circuit initiates a pulse for each input signal cycle applied to the external trigger input connector, provided that the input signal is compatible with the drive requirements.

When the FREQUENCY switch is in the external position, each time the SIGNLE CYCLE button is depressed, a single output pulse will occur.

b. Trigger Amplifier.
The trigger amplifier supplies the TRIGGER OUTPUT pulses. The output of the trigger amplifier follows the clock waveform, and therefore has an approximate 50% duty cycle. The trigger amplitude may be attenuated by a factor of 10 through a front panel selector switch.

c. Delay Multivibrator.
The delay multivibrator is a variable switch, one-shot which is initiated by the clock multivibrator or the external drive circuit. The DELAY range control selects a timing capacitor and the FINE delay control varies

the charging current to the timing capacitor.

d. Width Multivibrator.
The width multivibrator is a variable switch one-shot which determines the width of the output pulses. The width multivibrator is initiated by the output of the delay multivibrator. The period of the width multivibrator is determined by both the WIDTH range control and the FINE width control. The WIDTH control selects a timing capacitor, and the FINE width control varies the charging current to this timing capacitor.

e. Output Amplifier.
The output of the timing board is amplified by a series of emitter-coupled current mode switches with the output pulse resulting from the last set of current toggles. The output pulse is normally a negative pulse, to obtain a positive pulse, the logic levels into the output amplifier are inverted and a positive DC current source equal in magnitude to the output pulse current is added to the output of the amplifier. Polarity and inverting selection is done by the POLARITY switch.

f. Attenuator.
Two course output levels are available. .6-2V and .2-.6V amplitude is controlled by adjusting the variable negative supply to the output board.

g. Offset.
The offset source provides a positive or negative current to the output.

h. The output bias circuitry provides voltages to the output amplifier which track with offset and polarity to minimize the dissipation in the output devices.

3-3 CIRCUIT DESCRIPTION

a. Clock Multivibrator (Timing Board).
The clock multivibrator is the internal repetition frequency generator. It determines the repetition frequency of the pulse train in the free-running mode (the NORMAL position of the GATE switch) and the gated modes (+1.5V GATED ON and -1.5V GATED OFF positions of the GATE switch.)

The clock is an astable, emitter-coupled multivibrator made up of Q15 and Q18. Its free-running frequency is determined by the value of the emitter-coupling capacitor and the allowable voltage swings at the collectors. The FREQUENCY switch selects the value of the emitter-coupling capacitor. The FINE frequency control varies the frequency over the selected range by determining the voltage at the base of Q16 and Q17, the clamp transistors. In the free-running mode Q8, current source for the multivibrator is on. In the gated modes of operation, Q8 is turned off or on by the gate signals. With Q8 off, the clock stops operating as a free-running multivibrator.

To understand the operation of the clock multivibrator, assume that Q15 has just turned on. Q15's emitter current is approximately equal to the sum of the collector current of Q8 and the collector current of Q19, both current sources for the clock multivibrator. Q19's collector current flows through the timing capacitor, and the emitter of Q18 moves negatively. Note that since Q15 is on, its collector is at the level determined by clamp transistor Q16. Since the collector of Q15 is more negative than the collector Q18, the base of Q18 is more negative than the base of Q15. CR20 and CR21 are matched zener diodes. As the emitter Q18 ramps to a point such that it is one diode drop below the base of Q18, Q18 turns on. As Q18 turns on, the circuit regenerates and drives the base of Q15 more negative than the base of Q18. Q15 is now not conducting so the current of Q18 flows through the timing capacitor and the emitter of Q15 moves negatively. When the emitter of Q15 reaches a level sufficiently negative to turn it on again the cycle is repeated.

Current source Q8 is one-half of current toggle pair, Q8 and Q7. When Q8 is on, it

acts as a current source for Q15 of the multivibrator; when Q7 is on, Q8 is off, and Q15 cannot turn on. The gate signals and the external drive signals determine whether Q8 is on or off.

In the normal position of the gate switch, the collector of Q1 is biased above ground through R9 and the +15V supply. Hence, the base of Q3 will always be more positive than the base of Q4 since the collector of Q2 can never be more positive than ground. CR6 and CR7 are matched zeners. Since the base of Q3 is more positive than the base of Q4, Q3 is on, making the base of Q5 more negative than the base of Q6. Q5 is on which causes Q8 to be on allowing the clock to free run.

In the -1.5V GATED OFF mode, the GATE switch does not provide any biasing, so CR1 is forward-biased through CR3 and R6. Thus, the base of Q2 is more positive than the base of Q1 without any signal at J202, the gate input. Q2 can only be turned off when the input at J202 is more negative that -1.5V, making the base of Q2 more negative than Q1. With Q2 off, Q4 will be on and Q3 off. This in turn switches Q6 on and Q5 off, which in turn switches Q7 on and Q8 off. With Q8 off, there is no current to pull the emitter of Q15 negative and the clock stops for the duration of the input pulse.

In the +1.5V GATED ON mode, CR2 is forward-biased through +15 volts and R1, making the base of Q1 more positive than the base of Q2 with no input at J202. When the input at J202 is more positive than +1.5V, the base of Q2 is more positive than the base of Q1, Q4 is turned off and Q3 is turned on, which turns Q5 on and Q6 off. This turns on Q8 and turns off Q7, thus turning on the current source for the clock, allowing the clock to multivibrate for the duration of the input pulse.

IN the external drive mode, the clock transistors Q15 and Q18 are driven differentially through their emitters by the chain of current mode pairs of Q7 and Q8, Q9 and Q10, Q11 and Q12, Q13 and Q14. Q19 is turned off and so does not provide emitter current to Q18. The base of Q13 is biased up one diode drop by R45 and CR17, so Q13 is on when the input to J201 is near ground. When the input at J201 is such that Q14 is turned on, the signal is coupled through the three differential pairs and eventually turns on Q8 for the duration of the input signal. Now the clock merely acts as a follower for the external drive signal and the external drive signal is coupled through to the clock buffers, Q21 and Q22. In the single cycle mode, depressing the pushbutton discharges C220 into the external drive input to generate a single pulse.

b. Clock Amplifier and Trigger Circuit (Timing Board).

The clock signal is amplified through three amplifier pairs, Q21 and Q22; Q23 and Q24; and Q25 and Q26. These are emitter-coupled pairs that prepare the signal for the delay monostable multivibrator. Q23 drives Q27, the common base amplifier used as the trigger output. In the +1.5V trigger output position, the TRIGGER OUTPUT load sees all of Q27's collector current. In the +0.15V mode, the collector current is attenuated by resistors on the toggle switch.

c. Delay Multivibrator (Timing Board).

After amplification, the clock signals are differentiated at the input of the delay monostable multivibrator. The delay-one shot consists of Q29, Q30, Q31 and the current source Q32. Q29 and Q30 comprise a current toggle pair. The monostable multivibrator's period is determined by the capacitor selected by the DELAY range switch and the charging current determined by the FINE delay control. The one shot is in its stable state with Q30 on and Q29 off. Q31 conducts the current provided by current source Q32. This turns on CR34 and makes the base of Q30 one diode drop below ground so Q30 conducts the current from R82 and Q29 is off. The emitter level of Q31 is determined by Q30's

emitter current flowing through R91 and R87 to zener, CR36. The voltage across the capacitor at the emitter of Q31 is determined by the various IR and diode drops. When Q26 turns off, its positive-going edge is differentiated and drives the base of Q30. At the same time, the negative-going edge at Q25 is differentiated and drives the base of Q29. The differential pair, Q30 and Q29, change state so that Q30 is off and Q29 is on. When Q30 stops conducting, its collector voltage drops, and this reverse biases the emitter-base of Q31 so it stops conducting. In this state, CR35 is forward-biased through R81, ensuring that Q30 remains off for the duration of the one-shot's period. The base of Q31 is not very close to the supply level determined by CR36 since Q30 no longer conducts. The one-shot remains in this quasi-stable state until the current source can discharge the emitter capacitor sufficiently negative to turn Q31 on, and change the one-shot back to a stable state. The output of the delay monostable multivibrator is then amplified through pairs Q33 and Q34; Q35 and Q36; and Q37 and Q38, (all emitter-coupled pairs) to drive the width monostable multivibrator. Subsequent clock pulses are blocked until the multi times out.

d. Width Multivibrator (Timing Board).
Again, the signal is differentiated and the operation of the width monostable multivibrator, Q42, Q40, Q39, and current source Q41, is the same as the delay monostable multivibrator. The output of the width monostable multivibrator is amplified through current toggles Q46 and Q43 and fed to the output board drivers.

e. Output Board Drivers (Timing Board).
Current mode pairs Q45 and Q47 or Q44 and Q48 drive the output board and determine whether these drive signals are normal or inverted. If one pair is on, the drive is inverted. If the other pair is on, the drive is not inverted. Selection of one pair or the other is determined by the POLARITY switch which turns on either Q49 to supply emitter current for Q44 and Q48 or Q50 which supplies emitter current for Q45 and Q47.

f. Output Current Source Board.
Q2 and Q3 provide offset current for the output. Q1 and Q4 with adjustments R2 and R6 allow for compensation to keep the baseline constant when changing amplitude or polarity.

g. Amplitude.
Amplitude is controlled by the variable negative supply by Q304 on the regulator board. (See Diagram 2 of 7). The fine control is R6. The course change is the function of a voltage divider on the base of Q304.

h. Output Amplifier.
Output Amplifier consists of four stages of emitter coupled current toggles cascaded one after the other. They are coupled with matched Zeners and the pairs are matched together. To change amplitude, the emitter supply, variable negative supply is charged. The output is provided by Q9 & Q10 and the input from the current source board. The attenuator is a two position switch. The ranges are <200mV to >600mV and <600mV to >2V with overlap.

i. Offset.
Offset of the output waveform is accomplished by varying the current supplied by the current source board to Q9 to Q10. With the offset pot at zero only the output circuit determines the pulse parameters. If offset is changed, current is either added to or subtracted from that through the 50 ohm load to cause the baseline to move either positive or negative as desired.

j. Regulator Board.
The regulator board contains three supplies, +15V and -15V and variable negative supply. For the +15V supply, Q2 and Q3 are the differential sense amplifier that controls Q301 and Q1, the Darlington series pass transistors. R9 is used to adjust the supply level. The

sensing for the -15V supply is done through R12, R17, and Q5. Q5 drives Q4, which in turn, drives Q302, Q303, the -15V series pass elements. The variable negative supply is used to control the amplitude by regulating the current through Q304.

(A)

MODEL 129

SECTION IV

MAINTENANCE

SECTION 4
MAINTENANCE

4-1 GENERAL INFORMATION

This section of the manual gives maintenance notes and alignment procedures for the EH Model 129. The instrument requires a minimum amount of maintenance; however, normal aging of electronic components may eventually cause abnormal operation. Use of the procedures should forestall many minor malfunctions, or permit their detection before a major repair is required.

4-2 PREVENTIVE MAINTENANCE

a. Cleaning and Visual Inspection.

A regular program of inspection and maintenance is recommended to minimize down-time. The operating environment and amount of usage will dictate how often the instrument should be cleaned; in the absense of more stringent conditions, inspection every four to six months is recommended. Check the instrument in the following manner:

(1) Disconnect the power cord. Inspect the exterior of the instrument for broken knobs, switches or connectors.

(2) Remove the top and bottom covers. If the internal surfaces and components have an excessive amount of dust deposited on them, use a low-pressure stream of air and a soft brush to remove the foreign material.

CAUTION

Do not clean the printed circuit boards with solvents since damage to the circuits may result.

(3) Check the physical integrity of components and wiring. Look for evidence of loose connections, broken terminals, leakage of insulation compounds, and heat damage. In most cases, the source of a visually detected trouble is easily located. In the case of heat damage however, care should be taken to locate the original cause of the overheating before the instrument is put back into service.

b. Voltage Checks.
The following voltage checks will aid in locating possible trouble spots. The dc measurements can be made with a volt-ohm meter or any high impedance voltage meter; the ac measurements can be made with any real time oscilloscope with sensitivity in excess of 10 mV. At 115 VAC, the dc voltage between the chassis ground and the following points on the regulator board should have ripple of less than 10 mV.

Terminal	Voltage
Pin 17, Reg. Bd.	+14.8V $\pm$0.10V
Pin 15, Reg. Bd.	-15.0V $\pm$0.10V

4-3 PERFORMANCE VERIFICATION PROCEDURE

The following procedure serves as both a "covers on" receiving inspection and a check of the instrument's specifications. In the former sense, this check should be performed as soon as possible after receipt of the instrument. In the latter sense, the procedure can be used to verify the effectiveness of repairs or alignment.

a. Recommended Test Equipment.
The following is a list of the test equipment recommended for verifying proper operation of the EH Model 129 Pulse Generator.

(1) Oscilloscope. A fast risetime oscilloscope having sufficient passband for accurate observation of 500 pico second risetime pulses. Two vertical channels with dc offset capability are also necessary to make the correct measurements.

NOTE

$$TR\ observed = \sqrt{T_R^2\ generator + T_R^2\ scope}.$$

$$\sqrt{T_R^2\ Gen + T_R^2\ Scope}$$

(2) A general purpose oscilloscope with dc to 25 MHz passband.

(3) A digital voltmeter.

(4) A pulse generator having a repetition rate to 300 MHz and a variable output to at least 2V into 50 ohms.

(5) Several lengths of good quality 50-ohm coaxial cable and a high-quality 10:1 RF attenuator.

CAUTION

The full unattenuated output of the Model 129 is capable of permanently damaging the input of a sampling oscilloscope. In any attenuator position the Model 129 can deliver output levels greater than 2V. Be sure there is enough attenuation in the signal line to protect the scope. The trigger output of 1.5V can also potentially damage the oscilloscope's trigger input.

b. Initial Set-up.
The function of the front panel controls and connectors is described in an earlier section. During the checking of any particular function, controls for the other functions may be varied as necessary to maintain a meaningful presentation on the oscilloscope. Initial set-up of the front panel controls should be as follows:

POWER.....OFF
FREQUENCY...1-3 MHz
FINE.....ccw
DELAY.....10-30 ns
FINE.....ccw
WIDTH.....30-100 ns
FINE.....ccw
OFFSET.....centered near 0
POLARITY....Neg. Norm.
TRIGGER.....+0.15V
AMPLITUDE...ccw
GATE.....NORMAL

Connect the Model 129 TRIGGER OUT to the TRIGGER INPUT of the high passband oscilloscope to externally trigger the scope. Terminate the output of the Model 129 in 50 ohms and connect it to the input of the oscilloscope. Note that a sampling oscilloscope is terminated in 50 ohms and should have a X10 attenuator pad in the line.

Trigger the oscilloscope externally with the positive trigger, set the vertical sensitivity to display a 2V pulse and set the time base to display a 1 MHz pulse rate. Turn the POWER ON and adjust the trigger point on the oscilloscope if necessary. A pulse train should now appear on the oscilloscope.

c. Repetition Rate Check.
Requirement: internal clock frequency continuously variable from less than 10 kHz to more than 500 MHz, with overlap from each range into its next higher range.

The DELAY switch can be fixed at its lowest range and the WIDTH switch should be adjusted at the same time as the FREQUENCY switch so that the pulses are visible in the Max. Freq. Range. Note that a real time oscilloscope should be used for lower frequencies. Alternatively, a frequency counter may be used.

d. Width and Delay Check.
Requirement: both continuously variable from less than 2 ns to greater than 50 microsec. The check here is similar to the frequency check with the same set-up used. Check to see that the FINE controls overlap from one range into its neighboring range. Pulse width is measured at 50% amplitude. Pulse delay is measured from the 50% point on the leading

edge of the trigger to the 50% point on the leading edge of the output.

It will be necessary to adjust the frequency so that the period is greater than twice the width or delay. A general purpose oscilloscope should be used at long delays and widths. For short delays, the cable length of the trigger cable and the output cables should be of the same length in time.

e. Amplitude over 2V max.
Overlap in two attenuator ranges less than .2 volts min.

f. Offset.
Check for plus 1V and minus 1V offset around zero.

g. Rise and Fall Times.
Use fast risetime oscilloscope mentioned in paragraph a.(1). Adjust presentation for visual examination by making pulse full scale. Measure from 10% to 90% points for both risetime and falltime. If computations are necessary to accurately substantiate the 500ps risetime or falltime, it could be as follows:

661 = 360ps T_R
Desired T_R = 500ps

Observed $T_R = \sqrt{360^2 + 500^2}$

$T_R = \sqrt{129{,}960, + 250{,}000}$

$T_R = \sqrt{37{,}99{,}60}$ (616)

T_R observed should be less than 616ps, on 661 with 4S1 plug in.

Check in all polarities. This not only checks T_R and T_F but polarity switch function also.

h. Trigger Out.
+1.5V or +.15V. The frequency follows the clock. 50% duty cycle.

i. Gate +1.5V Gate ON/normal/ -1.5 Gate OFF. The 129 will gate to approximately 300MHZ. 129 being gated:

CLOCK.....approx 300MHZ
WIDTH.....3 ns
DELAY.....Min
AMP.....2V
POL.....Pos. Norm.
OFFSET.....Zero

Scope triggered by drive box:

CLOCK.....approx 100K
WIDTH.....approx 100ns
DELAY.....approx 100ns
AMPLITUDE.....1.5V Pos Gate ON
1.5V Neg Gate OFF

Scope timing 50ns/cm, sensitivity 200mv/cm

Result: clock should be OFF during time of negative pulse (Gate OFF switch position). Clock should be ON during time of positive pulse (Gate ON switch position).

Return gate switch to normal.

Adjustments:

a. Power Supply .+15 adjustable.

b. Timing Board. Symmetry control used to make clock output 50% ON +50% OFF (±5%).

c. Current source board/adjustments made to compensate for baseline shift when changing amplitude or polarity (+ to -).

MODEL 129

SECTION V

PARTS LIST

SECTION 5
PARTS LIST

5-1 ORDERING INFORMATION

Replacement parts may be ordered through an EH Representative or directly from the factory. To be certain of receiving the proper parts, always include the following information with the order:

a. Model number and serial number of the instrument on which the parts will be installed.

b. Circuit reference number and subassembly name, if applicable, for which the part is intended. If the part does not have a circuit reference, the description from the parts list should be used.

c. EH part number.

The warranty and instructions for in-warranty repair of this instrument are given on page ii of this manual, opposite the Table of Contents. For factory repair, contact the Customer Service Department. Include the following information:

a. Model number and serial number of the instrument on which the work is to be performed.

b. Details concerning the nature of the malfunction; or, type of repair desired.

5-2 HOW TO USE THIS PARTS LIST

The parts list is divided into subsections corresponding to the physical subsections of the instrument (printed circuit boards, chassis and subassemblies, miscellaneous hardware). Component locations can be determined from the schematic diagrams; each component appears only once in the parts list. At the beginning of each subsection are listed part numbers for any complete subassemblies in that category that are available as replacement parts. These subassemblies may include individually-listed components; care should be taken to locate malfunctions to the lowest possible level of replacement part and thus avoid the time and cost involved in "over-repair".

In the component descriptions, capacitor dielectrics are abbreviated as follows: polyethylene (poly.), ceramic (cer.), printed circuit (P.C.), electrolytic (elect.) and tantalum (tant.). Resistor and potentiometer values are given in ohms; the symbol for "ohm" (Ω) has been omitted. If no material is listed, resistors may be assumed to be carbon composition; other resistor types are metal film (MF) and wire-wound (WW). An asterik following a component value indicates that the actual value is factory-selected at time of manufacture; the listed value is nominal.

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ASSEMBLY NO. 129

DESCRIPTION PULSE GENERATOR

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	251-21138	Front Panel Assembly		1					
B									
C	*253-21096	Rear Panel Assembly		1					
D									
E	255-21140	Main Chassis Assembly		1					
F									
G	*257-21131	Side Panel Assembly		1					
H									
I	*261-21677	Frame Assembly 5½ X 12		1					
J									
K	*401-15029	Power Supply Regulator Assy		1					
L									
M	402-15038	Output Board Assy		1					
N									
O	402-15035	Timing Board Assy		1					
P									
Q	402-15032	Current Source Board Assy		1					
R									
S	820-15288	Standard Accessories		1					
T									

DRWN+ [illegible]

CHKD [illegible]

APPD [illegible]

*OTHER USAGES
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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	140-21141	Master Schematic	Prod Ref						
B									
C	*350-21694	Completion Kit (Bench)		1					
D		(OR)							
E	*350-21179	Completion Kit (Rack)	Prod Ref						
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

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ASSEMBLY NO 401-15029

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHOR
A	400-15028	P.C. Board		1					
B	401-15029	Assembly Drawing	Prod.Ref						
C	140-15030	Schematic	Prod.Ref						
D	316-00028	Cap., el., 25µf/25V	C3	1					
E	316-00035	Cap., el., 100µf/25V	C1,2	2					
F	374-00017	Diode, 1N746A	CR8,11	2					
G	374-00025	Diode, 1N754A	CR9	1					
H	376-00022	Diode, 1N914B	CR7,10	2					
I	551-00039	Potentiometer 200 Ω	R9	1					
J	596-00101	Res., 1/2W, 5%, 100Ω	R15	1					
K	596-00621	Res., 1/2W, 5%, 620Ω	R13	1					
L	596-00302	Res., 1/2W, 5%, 3K	R14	1					
M	596-00332	Res., 1/2W, 5%, 3.3K	R6	1					
N	596-00472	Res., 1/2W, 5%, 4.7K	R10	1					
O	596-00622	Res., 1/2W, 5%, 6.2K	R11	1					
P	596-00471	Res., 1/2W, 5%, 470Ω	R8	1					
Q	596-00431	Res., 1/2W, 5%, 430Ω	R7	1					
R	596-00821	Res., 1/2W, 5%, 820Ω	R16	1					
S	610-00017	Res., 10W, 5Ω, WW	R2	1					
T	610-00069	Res., 3W, 1Ω, WW	R1,3	2					

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ASSEMBLY NO. 129

DESCRIPTION PULSE GENERATOR

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TEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHO
A	140-21141	Master Schematic	Prod Ref						
B									
C	*350-21694	Completion Kit (Bench)		1					
D		(OR)							
E	*350-21179	Completion Kit (Rack)	Prod Ref						
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHOR
A	400-15028	P.C. Board		1					
B	401-15029	Assembly Drawing	Prod.Ref						
C	140-15030	Schematic	Prod.Ref						
D	316-00028	Cap., el., 25µf/25V	C3	1					
E	316-00035	Cap., el., 100µf/25V	C1,2	2					
F	374-00017	Diode, 1N746A	CR8,11	2					
G	374-00025	Diode, 1N754A	CR9	1					
H	376-00022	Diode, 1N914B	CR7,10	2					
I	551-00039	Potentiometer 200 Ω	R9	1					
J	596-00101	Res., 1/2W, 5%, 100Ω	R15	1					
K	596-00621	Res., 1/2W, 5%, 620Ω	R13	1					
L	596-00302	Res., 1/2W, 5%, 3K	R14	1					
M	596-00332	Res., 1/2W, 5%, 3.3K	R6	1					
N	596-00472	Res., 1/2W, 5%, 4.7K	R10	1					
O	596-00622	Res., 1/2W, 5%, 6.2K	R11	1					
P	596-00471	Res., 1/2W, 5%, 470Ω	R8	1					
Q	596-00431	Res., 1/2W, 5%, 430Ω	R7	1					
R	596-00821	Res., 1/2W, 5%, 820Ω	R16	1					
S	610-00017	Res., 10W, 5Ω, WW	R2	1					
T	610-00069	Res., 3W, 1Ω, WW	R1,3	2					

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHOR
A	610-00077	Res., 3W, 2Ω, WW	R4,5	2					
B	588-02001	Res., 1/2W, 1%, MF, 2K	R17	1					
C	588-01871	Res., 1/2W, 1%, MF, 1.87K	R12	1					
D	663-11725	Transistor	Q1-5	5					
E	376-00034	Diode 1N4005	CR1-6	6					
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	400-15034	PC Board		1					
B	402-15035	Assembly Drawing	Prod Ref						
C	140-15036	Schematic	Prod Ref						
D	144-15190	Silkscreen	Prod Ref						
E	402-16152	Clock Board Assembly		1					
F									
G	311-00002	Cap, Cerm 20pf 1KV 10%	C17	1					
H	311-00005	Cap, Cerm 30pf 1KV 10%	C29						
I	311-00008	Cap, Cerm 150pf	C30	1					
J	311-00009	Cap, Cerm 500pf 1KV 10%	C4,5,9,13, 15,19,27	7					
K	311-00007	Cap, Cerm 100pf 1KV 10%	C38	1					
L	311-00018	Cap, Cerm 5pf 1KV 10%	C28	1					
M	311-00033	Cap, Cerm .0015µf/1KV 10%	C20	1					
N	311-00038	Cap, Mono 1µf/25V 20%	C39	1					
O	311-00001	Cap, Cerm 10pf 1KV 10%	C1,2,11, C16	4					
P	311-00054	Cap Cerm 2.2pf	C40,41	2					
Q	311-00068	Cap Cerm HiQ 33pf	C10,26	2					
R	311-00006	Cap, Cerm 50pf	C8	1					
S									
T									

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	311-00077	Cap, Cerm 120pf 1KV 10%	C18	1					
B	311-00080	Cap, Cerm .002µf/1KV 10%	C32	1					
C	320-00005	Cap, Mylar .05µf/200V 5%	C23	1					
D	320-00022	Cap, Mylar .02µf/200V 5%	C34	1					
E	320-00023	Cap, Mylar .06µf/200V 5%	C35	1					
F	320-00024	Cap, Mylar .2µf/200V 5%	C36	1					
G	320-00025	Cap, Mylar .6µf 200V 5%	C37	1					
H	320-00031	Cap, Mylar .015µf 200V 5%	C22	1					
I	320-00036	Cap, Mylar .15µf	C24	1					
J	320-00041	Cap, Mylar .47µf 100V 1%	C25	1					
K	320-00066	Cap, Mylar .005µf 200V 5% SEI 17W	C21	1					
L	320-00067	Cap, Mylar .006µf200V 5% SEI 17W	C33	1					
M	326-00013	Cap, Poly 620pf 500V 5%	C31	1					
N									
O	374-00019	Diode	CR36,43	2					
P	374-00025	Diode, 1N754A	CR23	1					
Q	374-00064	Diode, Zener 1N756A	CR10	1					
R	374-11761	Diode, Zener MP	CR3,4,6-9 11-16,20,21						
S			24,25,31, 33,37-40						
T			44,45	24		•			

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	376-00022	Diode, 1N4448	CR59	1					
B	376-00079	Diode	CR19,22,34 35,41,42						
C			54-57,60, 61	12					
D	376-11764	Diode	CR1,2,5,17 18,30,32,						
E			46-53, 58	16					
F	551-00040	Potentiometer, Variable 1K	R59	1					
G	594-00100	Resistor 10Ω 1/8W 5%	R125,134	2					
H	594-00200	Resistor 20Ω 1/8W 5%	R69,73	2					
I	594-00201	Resistor 200Ω 1/8W 5%	R104,137	2					
J	594-00240	Resistor 24Ω 1/8W 5% q	R83,109	2					
K	594-00300	Resistor 30Ω 1/8W 5%	R54,55	2					
L	594-00390	Resistor 39Ω 1/8W 5%	R5,42,85, 87,103,112						
M			117,118, 150,151	10					
N	594-00120	Resistor 12Ω 1/8W 5%	R4,88,91, 116,135,						
O			144	6					
P	594-00510	Resistor 51Ω 1/8W 5%	R7,10,11, 16,26,31,32,						
Q			34,37,40,50 56,64,66,67						
R			89,92,94,96 121,123,15	22					
S	595-00051	Resistor 5.1Ω ½W 5%	R20,25,147	3					
T	595-00131	Resistor 130Ω ½W 5%	R80,98	2					

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	~~SHORT~~
A	595-00102	Resistor 1K ¼W 5%	R61	1					
B	595-00151	Resistor 150Ω ¼W 5%	R77,78,100 101	4					
C	595-00152	Resistor 1.5K ¼W 5%	R1,45,46, 58,136,145	6					
D	595-00150	Resistor 15Ω ¼W 5%	R23	1					
E	595-00182	Resistor 1.8K ¼W 5%	R6,8,12,14, 17,19,24,28						
F			30,33,36,38 41,68,72,76						
G			79,93,95,99 102,122,124						
H			128,133	25					
I	595-00200	Resistor 20Ω ¼W 5%	R148	1					
J	595-00201	Resistor 200Ω ¼W 5%	R43	1					
K	595-00203	Resistor 20K ¼W 5%	R47	1					
L	595-00271	Resistor 270Ω ¼W 5%	R18,29	2					
M	595-00272	Resistor 2.7K ¼W 5%	R3,44	2					
N	595-00302	Resistor 3K ¼W 5%	R62,63,129 132.152	5					
O	595-00431	Resistor 430Ω ¼W 5%	R13,35,65, 90,97,120	6					
P	595-00471	Resistor 470Ω ¼W 5%	R126,130	2					
Q	595-00472	Resistor 4.7K ¼W 5%	R127,131	2					
R	595-00511	Resistor 510Ω ¼W 5%	R60	1					
S	595-00561	Resistor 560Ω ¼W 5%	R2,39	2					
T	595-00560	Resistor 56Ω ¼W 5%	R22	1					

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	595-00680	Resistor 68Ω ¼W 5%	R84,110	2					
B	595-00682	Resistor 6.8K ¼W 5%	R106	1					
C	595-00751	Resistor 750Ω ¼W 5%	R21	1					
D	595-00752	Resistor 7.5K ¼W 5%	R81,108	2					
E	595-00821	Resistor 820Ω ¼W 5%	R48,53	2					
F	595-00910	Resistor 91Ω ¼W 5%	R27,49,52, 57	4					
G	596-00162	Resistor 1.6K ½W 5%	R51	1					
H	596-00271	Resistor 270Ω ½W 5%	R86,119	2					
I	596-00511	Resistor 510Ω ½W 5%	R9	1					
J	596-00751	Resistor 750Ω ½W 5%	R146 R82,111,	3					
K	586-01001	Resistor 1K 1/8W 1% MF	R105,114	2					
L	586-02490	Resistor 249Ω 1/8W 1% MF	R107,115	2					
M	586-05901	Resistor 5.9K 1/8W 1% MF	R113	1					
N	588-03740	Resistor 374Ω ½W 1% MF	R75	1					
O	588-02430	Resistor 243Ω ½W 1% MF	R71	1					
P	* 625-15281	Delay & Width Sw. Driver	R208,209	1					
Q	663-00070	Transistor 2N3904	Q32,41,49, 50	4					
R	663-00071	Transistor, 2N3906	Q20	1					
S	663-12528	Transistor Micro Tee PNP	Q5,6,9,10, 29,30,40 42	8					
T									

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	663-19245	Transistor NPN	Q1-4,7,8, 11-14,16,17						
B			19,21-27, 31,33-39,						
C			43-48	34					
D									
E	*704-15273	Cable, Timing Output, Assy		2					
F	704-15274	Cable Assy Gate Input/Trigger Input		2					
G	704-15276	Trigger Line Cable, Assy		1					
H	795-00011	Teflon tubing 22Ga	Prod Ref						
I									
J		-HARDWARE- (PIC Corp #CW-9) or Equiv							
K	202-00046	#4-40x¼ No-Mar Set Screw(2)	Prod Ref						
L	203-00018	#6-32x5/8 Lg BHMS (4)	Prod Ref						
M	475-00003	Spacer #6x3/8 Lg Non Treaded (2)	Prod Ref						
N									
O									
P									
Q									
R									
S									
T									

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ASSEMBLY NO. 402-15038

DESCRIPTION OUTPUT BOARD ASSEMBLY

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A	400-15037	PC Board		1					
B	402-15038	Assembly Drawing	Prod Ref						
C	140-15039	Schematic	Prod Ref						
D	144-15191	Silkscreen	Prod Ref						
E									
F	311-00038	Cap, Mono 1µf 25V	C11	1					
G	311-00054	Cap, Cerm 2.2pf	C10	1					
H	311-000 07	Cap, Cerm 100pf	C9	1					
I	311-00004	Cap, Cerm 220pf	C1-8	8					
J									
K *	335-15280	Choke	L1	1					
L	374-11797	Diode, 1N746A MP	CR1-10	5					
M									
N	410-15159	Base, Solder Fixture	Prod Ref						
O	410-15160	Clamp, Solder Fixture	Prod Ref						
P									
Q	594-00300	Resistor 30Ω 1/8W 5%	R22	1					
R	594-00510	Resistor 51Ω 1/8W 5%	R1,2	2					
S	595-00242	Resistor 2.4K ½W 5%	R3,4,8,9, 13,14,						
T			18,20	8					

*SEE S/A FILE

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

WHERE USED
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INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 402-15038

DESCRIPTION OUTPUT BOARD ASSEMBLY

B/M PAGE 9
COPY DATE 6-4-73
E.C.O. 82-009
85-155

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	595-00300	Resistor 30Ω ¼W 5%	R21	1					
B	595-00430	Resistor 43Ω ¼W 5%	R15,17	2					
C	595-00470	Resistor 47Ω ¼W 5%	R10,12	2					
D	595-00510	Resistor 51Ω ¼W 5%	R5,7	2					
E	595-00511	Resistor 510Ω ¼W 5%	R27	1					
F	595-00681	Resistor 680Ω ¼W 5%	R28	1					
G	595-00821	Resistor 820Ω ¼W 5%	R23,26	2					
H	595-00910	Resistor 91Ω ¼W 5%	R25	1					
I	596-00131	Resistor 130Ω ½W 5%	R24	1					
J	596-00241	Resistor 240Ω ½W 5%	R11,19	2					
K	596-00301	Resistor 300Ω ½W 5%	R6	1					
L	596-00820	Resistor 82Ω ½W 5%	R29	1					
M	610-00042	Resistor 200Ω 3W w.w.	R16	1					
N									
O	663-15300	Transistor MP	Q1-10	5					
P									
Q	721-00035	Connector, SMB PC Mt Jack	A,B	2					
R	721-15279	Output Bd. to GR Connector Assembly Procedure	Prod Ref						
S	739-00001	Teflon Bead GR#0874-0707		1					
T	739-00004	Conductor, Outer GR#0874-0603		1					

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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ASSEMBLY NO. 402-15038

DESCRIPTION OUTPUT BOARD ASSEMBLY

B/M PAGE 10
COPY DATE 6-4-73
E.C.O. 74-044

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTENSION	SHORT
A	739-00005	Conductor, Inner GR#0874-0612		1					
B	739-00006	Retaining Ring GR#0874-0810		2					
C	739-00016	Mounting Nut GR#5810-1700		1					
D	739-00017	Mounting Cup GR		1					
E	739-00023	Coupling Nut GR#0874-6187		1					
F	739-00025	Inner Transition Piece GR#0874-6279		1					
G	739-15111	Connector, Modification		1					
H									
I	262-22279	Bracket Output Bd.		1					
J	484-00039	Card Guide		2					
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

WHERE USED
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INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 402-15032

DESCRIPTION CURRENT SOURCE BOARD ASSEMBLY

B/M PAGE 17
COPY DATE 6-4-73
E.C.O. 78-005
85-155

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	400-15031	PC Board		1					
B	402-15032	Assembly Drawing	Prod Ref						
C	140-15033	Schematic	Prod Ref						
D									
E	311-00010	Cap, Cerm .001μf/1KV 10%	C1-4	4					
F	335-14688	Choke	L1	1					
G	374-00065	Diode 1N758A	CR3	1					
H	376-00031	Diode, 1N270	CR1	1					
I	551-00053	Potentiometer 200Ω	R2,6	2					
J	595-00102	Resistor 1K ¼W 5%	R13	1					
K	595-00511	Resistor 510 ½W 5%	R12	1					
L	588-04990	Resistor 499Ω ½W 1% MF	R3	1					
M	588-01501	Resistor 1.5K ½W 1% MF	R1,9	2					
N	588-03011	Resistor 3.01K ½W 1% MF	R8	1					
O	588-02150	Resistor 215Ω ½W 1% MF	R5,10	2					
P	588-06190	Resistor 619Ω ½W 1% MF	R7	1					
Q	588-01581	Resistor 1.58K ½W 1% MF	R4	1					
R	588-03830	Resistor 383Ω ½W 1% MF	R11	1					
S	663-00070	Transistor 2N3904	Q1,4	2					
T	663-00071	Transistor 2N3906	Q2,3	2					
U									
V									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

WHERE USED
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402-15035

INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 402-16152

DESCRIPTION CLOCK BOARD ASSEMBLY

B/M PAGE 26
COPY DATE 6-4-73
E.C.O. 74-045
78-015

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	400-16151	PC Board		1					
B	402-16152	Assembly Drawing	Prod Ref						
C									
D	311-00089	Cap, 220pf	C3,6	2					
E	663-19245	Transistor	Q15,18	2					
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

WHERE USED
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INDEX [ ] ASSEMBLY [X] SPEC. ASSEM. [ ]

B/M PAGE 3
COPY DATE 6-4-73
E.C.O.

ASSEMBLY NO. 251-21138

DESCRIPTION FRONT PANEL ASSEMBLY

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	250-21142	Panel, Front		1					
B	144-21139	Silkscreen, Front Panel	Prod Ref						
C									
D	443-00049	Knob, Large		5					
E	443-00048	Knob, Small		5					
F	550-00001	Potentiometer, 500Ω	R205,224	2					
G	550-00003	Potentiometer, 5K	R201	1					
H	550-00012	Potentiometer, 10K R22	R220,211	2					
I	594-00471	Resistor 470Ω 1/8W 5%	R221	1					
J	594-00560	Resistor 56Ω 1/8W 5%	R222	1					
K	465-23944	Coupling, Index Shaft		2					
L	624-00018	Switch, Polarity	S205	1					
M	630-00022	Switch, Power	S201	1					
N	630-00013	Switch, Toggle	S202-	1					
O	630-00019	Switch , Toggle C&K7211	S206	1					
P	635-00013	Switch, Pushbutton	S203	1					
Q	625-15282	Switch, Amplitude Assy	S204	1					
R	625-21152	Switch, Frequency Assy	S207	1					
S	624-21134	Index 36°		2					
T	311-00033	Cap, Cerm .0015μf/1KV 10%	C219	1					

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 251-21138

DESCRIPTION FRONT PANEL ASSEMBLY

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FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	702-15327	Wire List, General	Prod Ref						
B	702-15326	Wire List Polarity Switch	Prod Ref						
C	704-15275	Trigger Output Cable Assy		1					
D									
E									
F									
G		-HARDWARE-							
H	203-00007	#6-32x½ FHMS (4)	Prod Ref						
I	202-00018	#4-40x3/8 FILHD (4)	Prod Ref						
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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129

INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 255-21140

DESCRIPTION CHASSIS ASSEMBLY

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COPY DATE 6-4-73
E.C.O. 73-049 82-02
ECO 74-044
9(76)

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	254-21135	Chassis		1					
B	144-21136	Silkscreen, Chassis	Prod Ref						
C									
D	258-13061	Cover, Terminal		1					
E									
F	330-00005	Cover, Capacitor		1					
G	262-14568	Bracket, PCB Guide		2					
H	311-00038	Cap, Mono, 1.0µf/25V	C303	1					
I	316-00045	Cap, El, 1500µf/50V DC	C302	1					
J	316-00079	Cap, El, 3300µf/50V DC	C301	1					
K	484-00023	Terminal Strip Jumper		2					
L	484-00036	Terminal Strip 6 Point		1					
M	484-00037	Terminal Strip Plate		1					
N	405-00007	Cap Clamp, 2"	(C301)	1					
O	490-00001	Socket, Transistor		4					
P	596-00103	Resistor 10K ½W 5%	R301,302	2					
Q	650-10562	Transformer	T301	1					
R	655-10564	Inductor	L301	1					
S	663-11705	Transistor	Q301-304	4					
T	484-00039	Card Guide		2					

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ASSEMBLY NO. 255-21140

DESCRIPTION CHASSIS ASSEMBLY

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COPY DATE 6-4-73
E.C.O. 82-025

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	702-15290	Cable Harness, Main		1					
B	704-21214	Cable, Internal AC, Assy		1					
C									
D	702-15291	Wire List, Main Harness	Prod Ref						
E	743-00008	Connector, 18 Pin		1					
F									
G		-HARDWARE-							
H									
I	475-00025	#4-40x¼ Standoff (2)	Prod Ref						
J	410-00002	Cable Clamp (3)	Prod Ref						
K		#10 Solder Lug (2)	Prod Ref						
L	203-00008	#6-32x3/8 BHMS (7)	Prod Ref						
M	202-00019	#4-40x½ BHMS (2)	Prod Ref						
N	202-00020	#4-40x½ FHMS (12)	Prod Ref						
O	205-00002	#10-32x3/8 BHMS (6)	Prod Ref						
P	240-00004	#10-32 Kep Nut (8)	Prod Ref						
Q	205-00005	#10-32x½ BHMS (2)	Prod Ref						
R	410-00008	Cable clamp (1)	Prod Ref						
S	460-00002	#4 Solder Lug (3)	Prod Ref						
T		#4-40x3/8 Standoff (1)	Prod Ref						

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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ASSEMBLY NO. 255-21140

DESCRIPTION CHASSIS ASSEMBLY

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FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A		#4-40x5/8 Standoff (2)	Prod Ref						
B	203-00045	#6-32x1" FHMS 82° (2)	Prod Ref						
C	420-00006	Grommet ½" Grove Dia (1)	Prod Ref						
D									
E									
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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251-21138
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INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO 625-21152

DESCRIPTION FREQUENCY SWITCH ASSEMBLY

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COPY DATE 6-4-73
E.C.O.

FILLED BY _____ DATE _____ RELEASED TO _____ DATE _____

ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	311-00035	Cap, Cerm 15pf 1KV 10%	C206-208	3					
B	311-00004	Cap, Cerm 250pf 1KV 10%	C209,210	2					
C	311-00009	Cap, Cerm 500pf 1KV 10%	C211	1					
D	311-00018	Cap, Cerm 5pf 1KV 10%	C202,203 204,218	4					
E	311-00007	Cap, Cerm 100pf 1KV 10%	C220	1					
F	311-00022	Cap, Cerm 3.3pf 1KV	C201	1					
G	311-00001	Cap, Cerm 10pf 1KV	C205	1					
H	311-00054	Cap, Cerm 2.2pf 1KV	C217	1					
I	320-00017	Cap, Mylar .025μf 200V 5%	C214	1					
J	320-00021	Cap, Mylar .25μf 200V 5%	C216	1					
K	320-00055	Cap, Mylar .075μf 200V 5%	C215	1					
L	320-00057	Cap, Mylar .007μf 200V 5%	C213	1					
M	320-00068	Cap, Mylar .0025μf 200V 5%	C212	1					
N	595-00910	Resistor 91Ω ¼W 5%	R213,214, 215,225	4					
O	595-00750	Resistor 75Ω ¼W 5%	R216-218	3					
P	595-00100	Resistor 10Ω ¼W 5%	R212,219	2					
Q	595-00200	Resistor 20Ω ¼W 5%	R208,226	2					
R	595-00131	Resistor 130Ω ¼W 5%	R207	1					
S	595-00103	Resistor 10K ¼W 5%	R210	1					
T	596-00151	Resistor 150Ω ½W 5%	R209	1					

DITTOFORMS

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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INDEX ☐ ASSEMBLY ☒ SPEC. ASSEM. ☐

ASSEMBLY NO. 625-21152

DESCRIPTION FREQUENCY SWITCH ASSEMBLY

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ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	~~SHORT~~
A	596-00226	Resistor 22M ⅓W 5%	R223	1					
B									
C	376-00022	Diode, 1N4448	CR200	1					
D									
E	624-00029	Switch, Index	S201	1					
F	624-00001	Switch, Deck	1F-3F 5F,6F	5					
G	624-00020	Switch Deck	4F	1					
H	625-21129	Freq. Switch Sub-Assy	Prod Ref						
I	702-15324	Wire List, Freq. Switch	Prod Ref						
J									
K									
L		-HARDWARE-							
M	215-00012	Washer (2)	Prod Ref						
N	460-00005	Solder Lug (1)	Prod Ref						
O									
P									
Q									
R									
S									
T									

JOB NO.	ASSEMBLIES REQ'D.	COST CENTER	DATE

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ASSEMBLY NO. 820-15288

DESCRIPTION STANDARD ACCESSORIES

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E.C.O. 77-022

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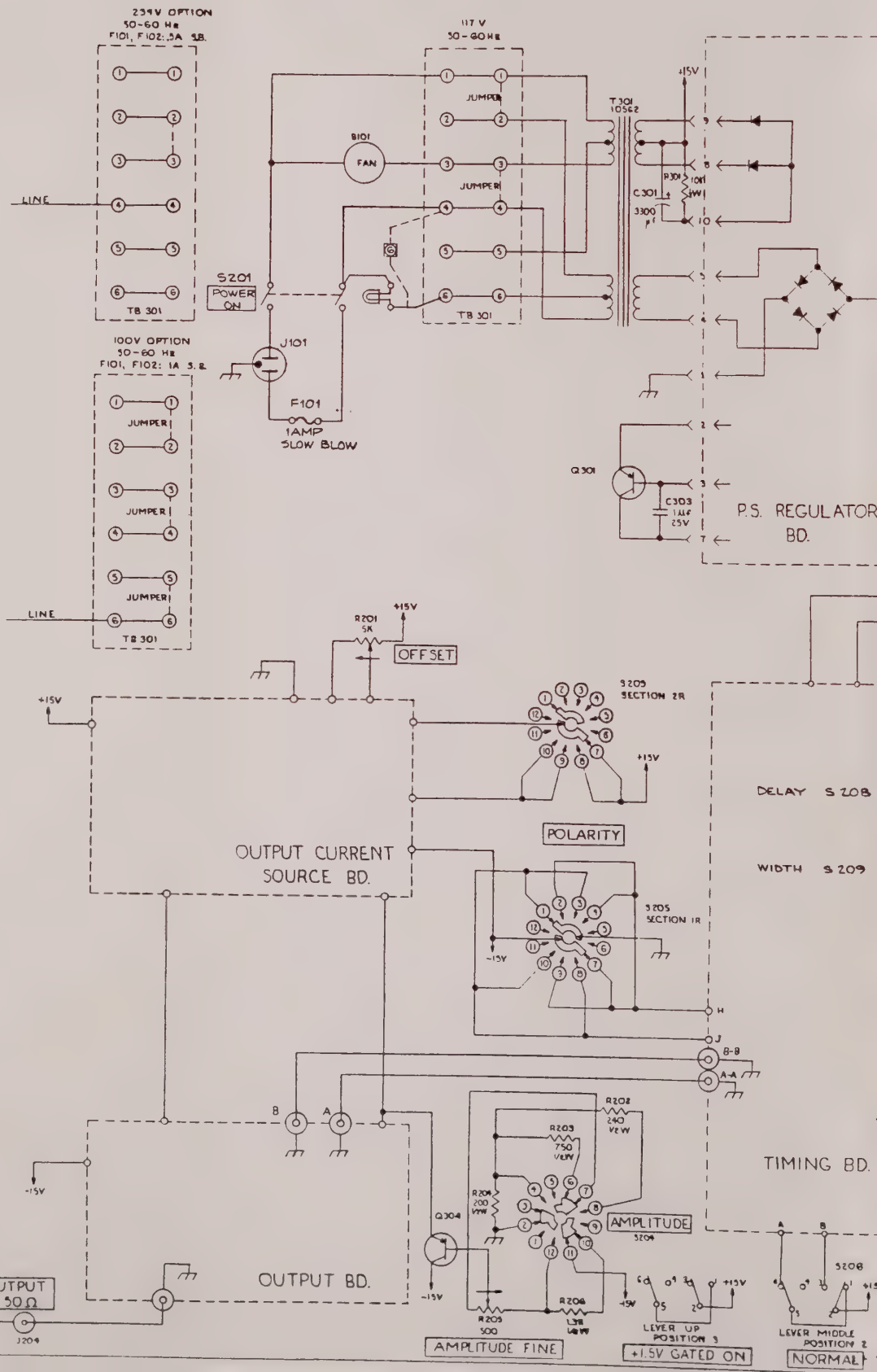
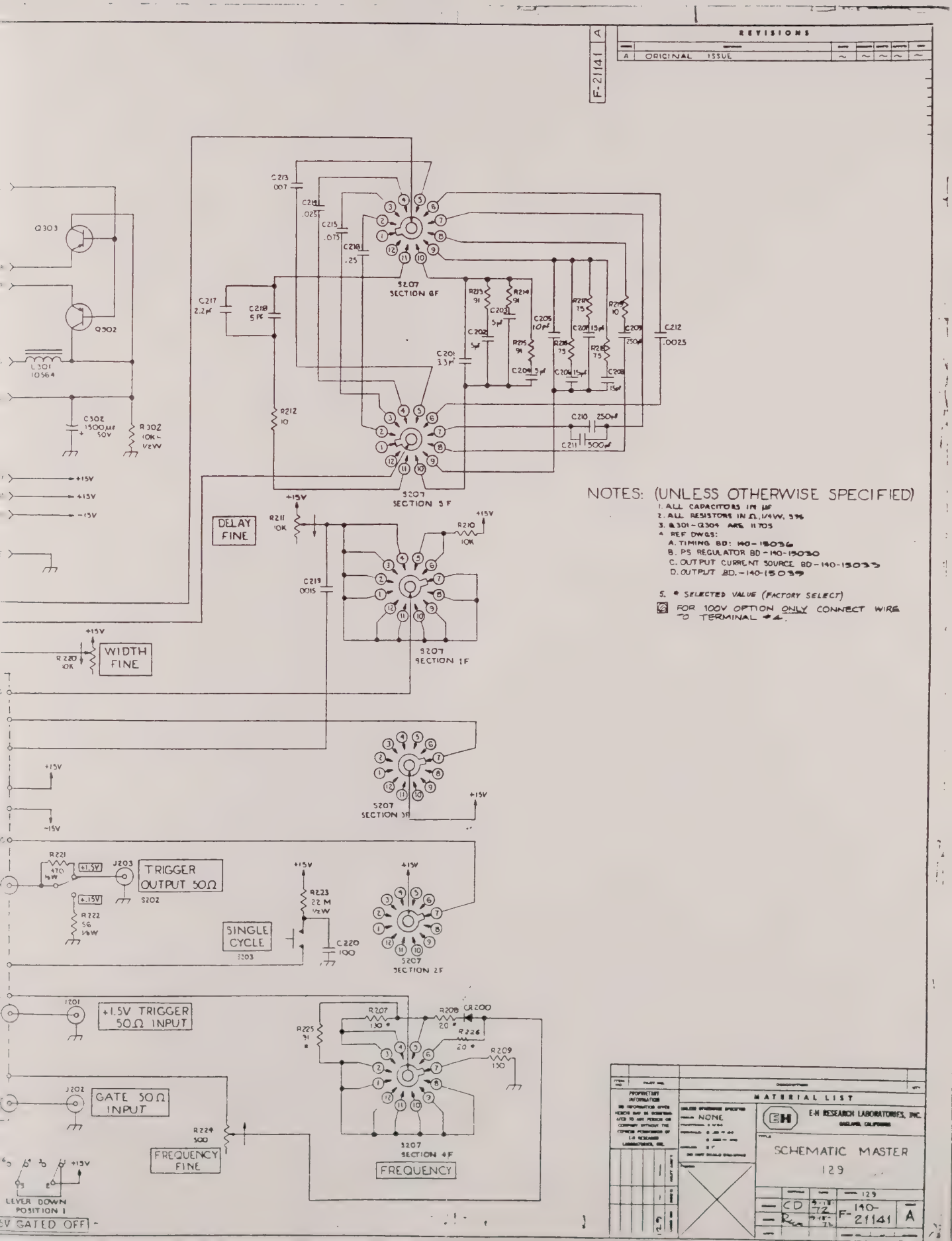
ITEM	ASSEMBLY OR PART NO.	DESCRIPTION	SCHEMATIC REF.	Q.T. ASSEM.	ISSUED	UNIT COST	UNIT	EXTEN-SION	SHORT
A	148-06909	Manual		1					
B									
C	786-00020	Power Cord		1					
D	800-00032	Envelope		1					
E									
F									
G									
H									
I									
J									
K									
L									
M									
N									
O									
P									
Q									
R									
S									
T									

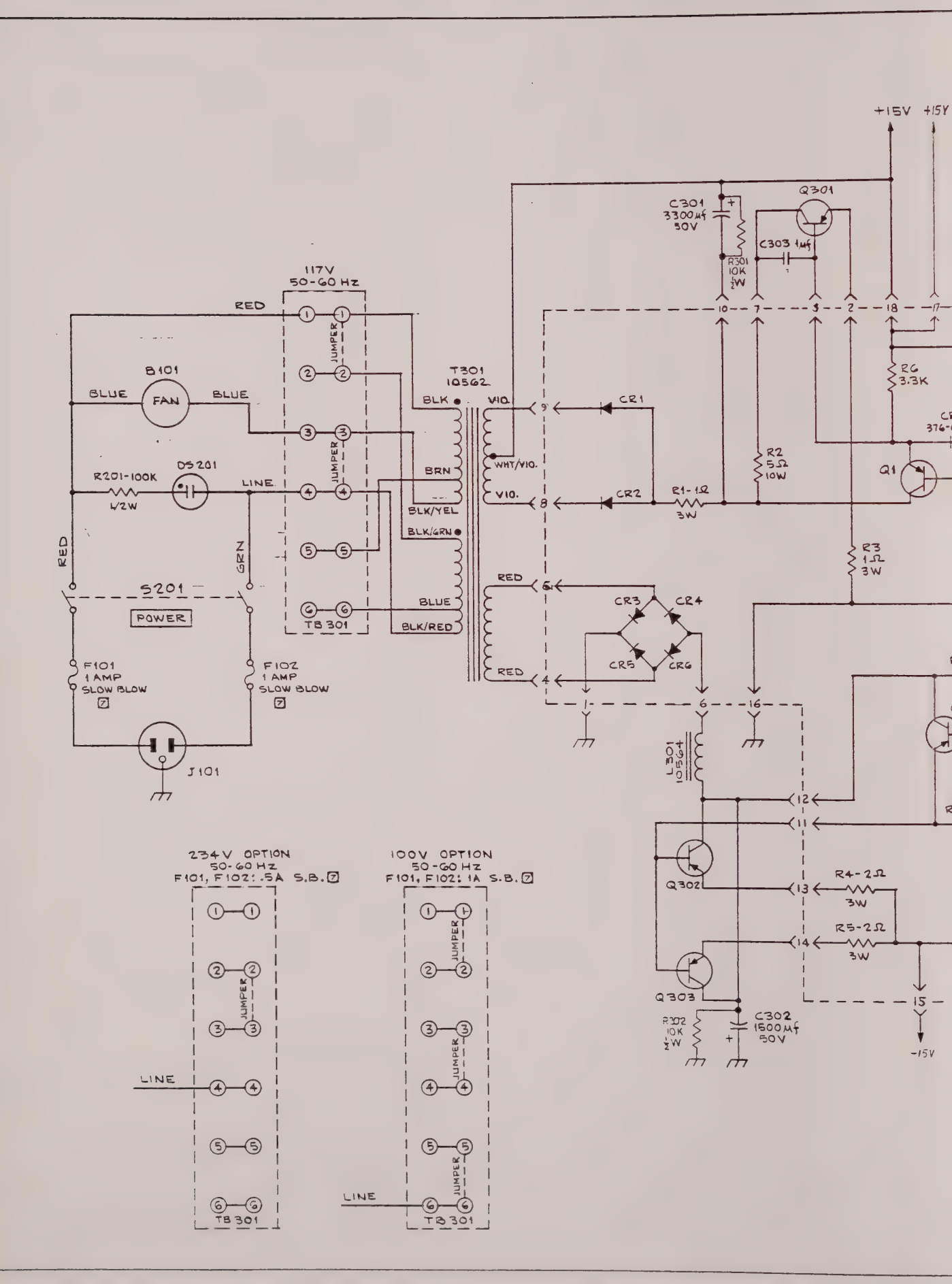
MODEL 129

SECTION VI

DRAWINGS


234V OPTION
50-60 Hz
F101, F102: .5A SB.
117 V
50-60 Hz
LINE
TB 301
S201
POWER ON
B101
FAN
JUMPER
T301
10562
+15V
C301
3300 pf
P301
10Ω 1W
J101
F101
1AMP
SLOW BLOW
100V OPTION
50-60 Hz
F101, F102: 1A S.B.
Q301
C303
P.S. REGULATOR BD.
R201
5K
OFFSET
S205
SECTION 2R
POLARITY
OUTPUT CURRENT SOURCE BD.
S205
SECTION 1R
DELAY S 208
WIDTH S 209
TIMING BD.
B-B
A-A
R202
240 VCW
R203
750 VCW
R204
200 VCW
Q204
AMPLITUDE
S204
R205
500
R206
L3R LCW
AMPLITUDE FINE
OUTPUT BD.
OUTPUT
50Ω
J204
LEVER UP
POSITION 3
+1.5V GATED ON
S208
LEVER MIDDLE
POSITION 2
NORMAL

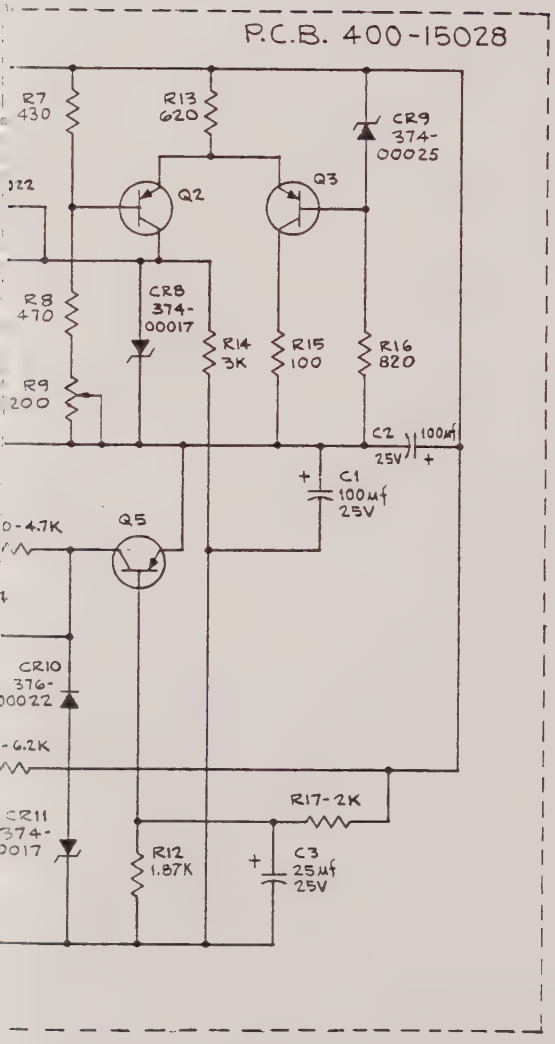

REVISIONS
A ORIGINAL ISSUE
F-21141 A
Q303
Q302
L301 10564
C302 1500μF 50V
R302 10K ½W
+15V
+15V
-15V
C213 .007
C214 .025
C215 .075
C216 .25
S207 SECTION 6F
C217 2.2μF
C218 5PF
R212 10
C201 3.3μF
R213 91
R214 91
C202 5μF
C203 5μF
C205 10μF
R215 91
C204 5μF
R216 75
C206 15μF
R217 75
C207 15μF
R218 10
C208 15μF
C209 250μF
C212 .0025
C210 250μF
C211 500μF
S207 SECTION 5F
DELAY FINE
R211 10K
+15V
R210 10K
C219 .0015
S207 SECTION 1F
+15V
R220 10K
WIDTH FINE
S207 SECTION 3F
+15V
-15V
R221 470 ½W
+15V
J203
TRIGGER OUTPUT 50Ω
S202
+15V
R222 56 ½W
SINGLE CYCLE
S203
+15V
R223 22 M ½W
C220 100
S207 SECTION 2F
+15V
J201
+1.5V TRIGGER 50Ω INPUT
R225 91
R207 130
R208 20
CR200
R226 20
R209 130
J202
GATE 50Ω INPUT
R224 500
FREQUENCY FINE
S207 SECTION 4F
FREQUENCY
+15V
LEVER DOWN POSITION 1
V GATED OFF
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL CAPACITORS IN μF
2. ALL RESISTORS IN Ω, 1/4W, 5%
3. Q301-Q304 ARE 11705
4. REF DWGS:
A. TIMING BD: 140-15036
B. PS REGULATOR BD-140-15030
C. OUTPUT CURRENT SOURCE BD-140-15035
D. OUTPUT BD.-140-15039
5. * SELECTED VALUE (FACTORY SELECT)
FOR 100V OPTION ONLY CONNECT WIRE TO TERMINAL #4.
MATERIAL LIST
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA
SCHEMATIC MASTER
129
CD 72
F-140-21141 A


+15V
+15V
Q301
C301
3300µf
50V
C303 1µf
R301
10K
½W
117V
50-60 Hz
RED
JUMPER
B101
FAN
BLUE
BLUE
T301
10562
BLK
VIO.
CR1
BRN
WHT/VIO.
R2
5Ω
10W
R201-100K
½W
DS201
LINE
VIO.
CR2
R1-1Ω
3W
Q1
R6
3.3K
BLK/YEL
BLK/GRN
R3
1Ω
3W
RED
GRN
S201
POWER
RED
BLUE
BLK/RED
CR3
CR4
CR5
CR6
F101
1 AMP
SLOW BLOW
7
F102
1 AMP
SLOW BLOW
7
TB 301
J101
L301
10564
Q302
R4-2Ω
3W
R5-2Ω
3W
Q303
R302
10K
½W
C302
1500µf
50V
-15V
234V OPTION
50-60 Hz
F101, F102: .5A S.B. 7
100V OPTION
50-60 Hz
F101, F102: 1A S.B. 7
LINE
LINE
TB 301
TB 301

D-15030 E

REVISIONS

		DATE	DRAWN	CHK'D	APP'D	ECO
A	ORIG. RELEASE	~	~	~	~	~
B	1.3K WAS 1.1K ON AMPLITUDE CONTROL	7-29-69	GHG	DS		DCN 3/4
C	R12 WAS 1.8K & ADDED R301 & R302	10-6-69	ETS	MSB	—	DCN 4
—	CHANGED S204	—	—	—	—	—
D	ADD 122A USAGE	4-13-72	GA	MSB		DCN 37
E	DELETE C304 .01 AT Q302 BASE TO COLL.;	—	—	—	—	—
—	REVISE NOTE [7]	7-11-72	GA			72-029



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTORS ARE IN OHMS; 1/2W, 5%.
2. R12 & R17 ARE METAL FILM, 1%.
3. ALL DIODES ARE IN4005.
4. ALL TRANSISTORS ON BOARD ARE 11725.
5. ALL TRANSISTORS OUTSIDE BOARD ARE 11705.
6. REF. DWGS:
   P.C.B. FAB. 400-15028
   P.C.B. ASSY 401-15029

[7] 122A: F101 & F102 ARE 1.5A SB FOR 100 V & 117 V AND .75A SB FOR 230V.

ITEM NO.	PART NO.	DESCRIPTION	QTY

MATERIAL LIST

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

UNLESS OTHERWISE SPECIFIED
SCALE NONE
FRACTIONAL ± 1/64
DECIMALS .XX ± .03
.XXX ± .010
ANGLES ± 1°
DO NOT SCALE DRAWING

FINISH NONE

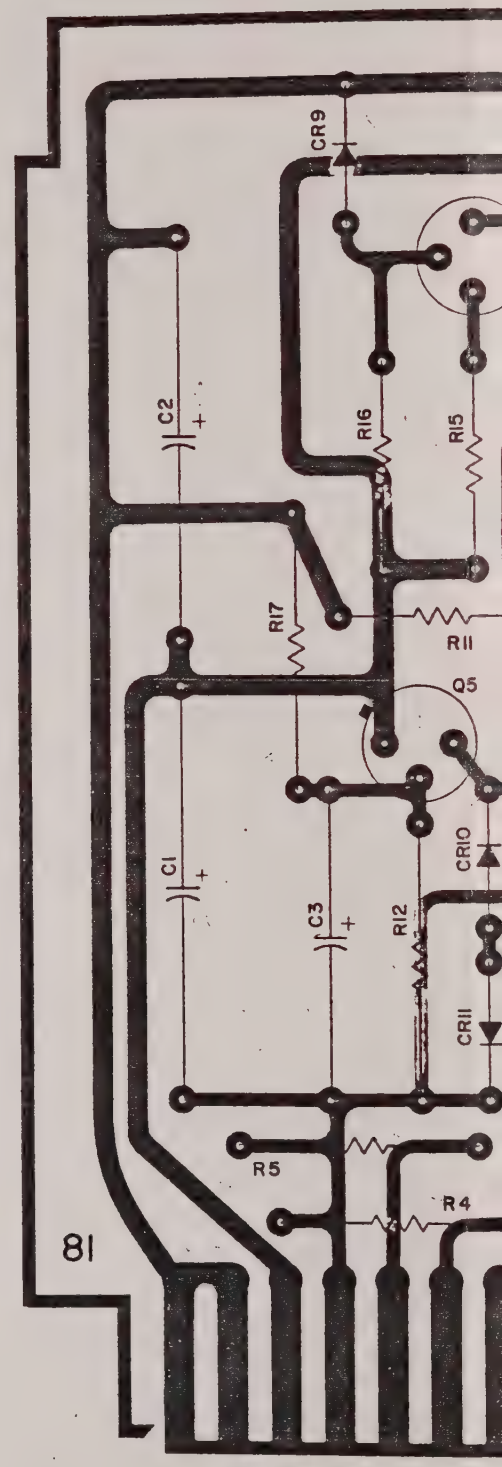
NEXT ASSY	REQ'D	USED ON
401-15029	—	122A
401-15029	—	125

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE: SCHEMATIC, P.S. REGULATOR BD

SIZE 129

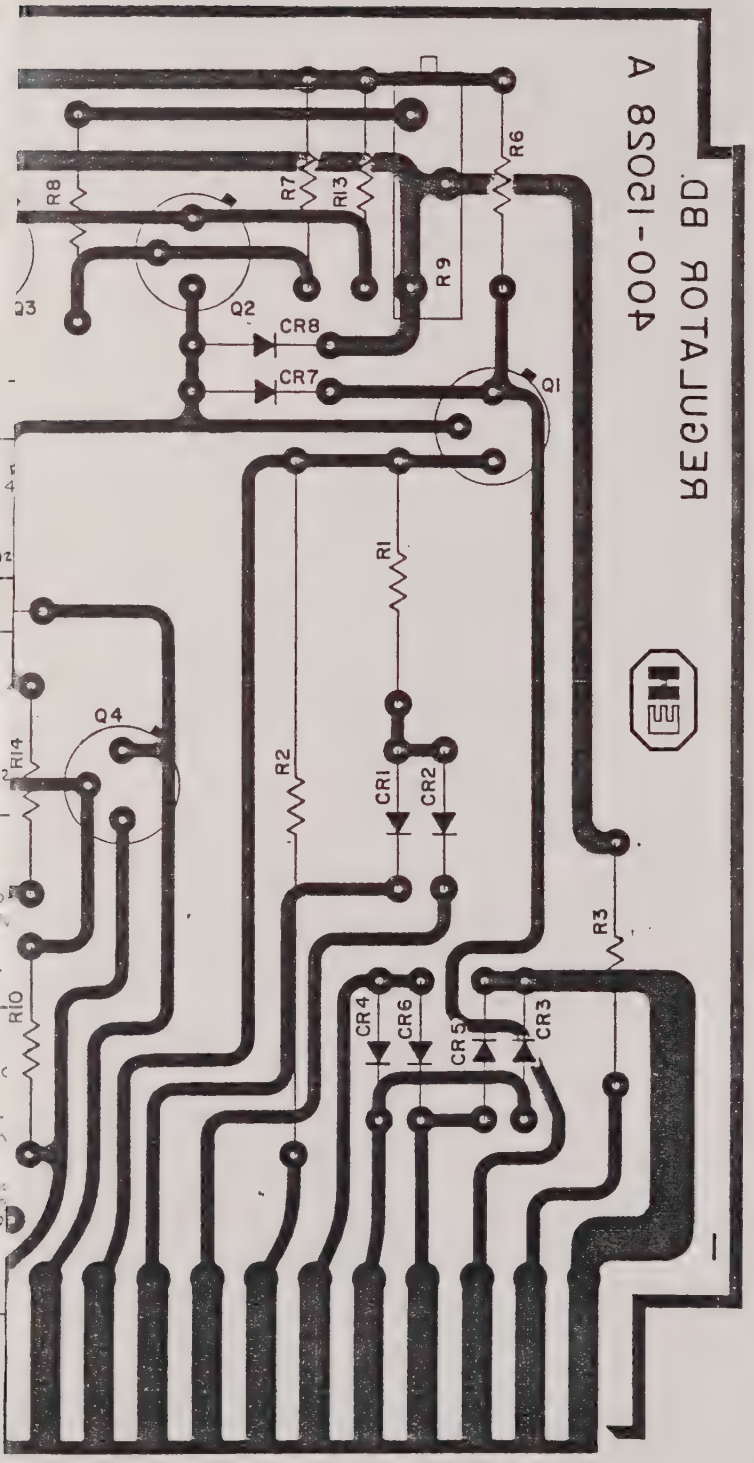
	INITIALS	DATE	DWG. NO.	REV.
DRAWN	G.L.	2/26/69	D-140-15030	E
CHK'D		3-27-69		
APP'D			SHEET NO. 1 OF 1 SHEETS	



REF. DWG'S

1	BOARD OUTLINE	C-13399
2	FAB (SPEC) DWG	C-400-15028
3	ASSEMBLY DWG	C-401-15029
4	SCHEMATIC DWG	D-140-15030

ISSUE	REVISION
A	ORIG. RELEASE



REVISIONS

	DATE	DRAWN	CHK'D	APPV'D	E.O.

E-H RESEARCH LABORATORIES, INC.
OAKLAND CALIFORNIA

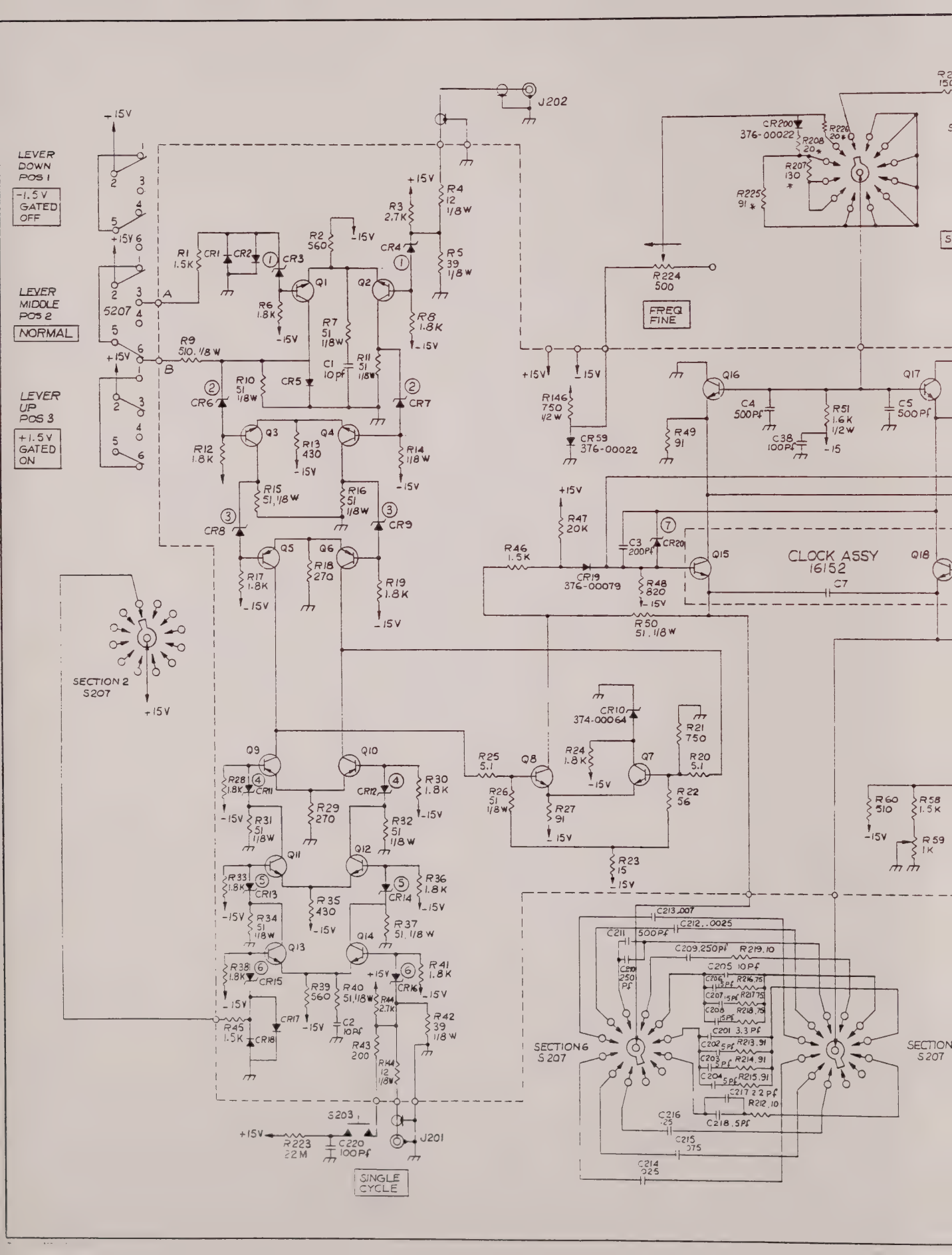
ASSEMBLY DRAWING
REGULATOR BOARD

USED ON	FSCM NO.	NEXT ASSY
129		

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

	NAME	DATE
DRAWN	E.D.L.	9-17-69
CHK'D	J.C.	21 AUG 69
APP'D		

SIZE 129
401-C-15029
ISSUE A
SHEET NO. 1 OF 1


LEVER DOWN POS 1
-1.5 V GATED OFF
LEVER MIDDLE POS 2
NORMAL
LEVER UP POS 3
+1.5 V GATED ON
5207
J202
J201
S203
SINGLE CYCLE
FREQ FINE
R224 500
CLOCK ASSY 16152
SECTION 2 S207
SECTION 6 S207
SECTION S207
CR200 376-00022
CR59 376-00022
CR19 376-00079
CR10 374-00064
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
R1 1.5K
R2 560
R3 2.7K
R4 12 1/8W
R5 39 1/8W
R6 1.8K
R7 51 1/8W
R8 1.8K
R9 510, 1/8W
R10 51 1/8W
R11 51 1/8W
R12 1.8K
R13 430
R14 1/8W
R15 51, 1/8W
R16 51 1/8W
R17 1.8K
R18 270
R19 1.8K
R20 5.1
R21 750
R22 56
R23 15
R24 1.8K
R25 5.1
R26 51 1/8W
R27 91
R28 1.8K
R29 270
R30 1.8K
R31 51 1/8W
R32 51 1/8W
R33 1.8K
R34 51 1/8W
R35 430
R36 1.8K
R37 51, 1/8 W
R38 1.8K
R39 560
R40 51, 1/8W
R41 1.8K
R42 39 1/8 W
R43 200
R44 12 1/8W
R45 1.5K
R46 1.5K
R47 20K
R48 820
R49 91
R50 51, 1/8 W
R51 1.6K 1/2W
R146 750 1/2 W
R207 130
R208 20
R220 20
R225 91
R60 510
R58 1.5K
R59 1K
C1 10 pf
C2 10 pf
C3 200 pf
C4 500 pf
C5 500 pf
C38 100 pf
C7
C211 500 pf
C220 100 pf
R223 22 M
+15V
-15V

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	ECO
J	SCHEMATIC REDRAWN, SEE PAGE 2	5-21-86	HL			B5-1V

D-15036

ECTION 4
S 207

201 FREQUENCY SWITCH

Q3

R221
470, 1/8W

1.5V

J203

1.5V

R222
56
1/8W

TRIGGER
OUTPUT
50Ω

S 202

R52
91

R64
51
1/8 W
⑧

R55
30, 1/8W

CR24

Q21

R66
51, 1/8W

C11
10Pf

CR21
⑦

C6
220Pf

R54
30, 1/8W

R53
820

-15V

R65
430

-15V

R68
1.8K

-15V

R69
20, 1/8W

Q27

TO R83

Q23

⑨

CR31

Q25

R75
374, 1%,
1/2W

+15V

R76
1.8K

-15V
Q27

C39
1.0

R147
5.1

CR52

CR53

CR32

R71
243
1%
1/2W
-15V

R77
150

R78
150

-15V

Q22

⑧

CR25

Q24

CR 33

Q26

TO R80

R56
51
1/8 W

R67
51
1/8W

R72
1.8K

-15V

R73
20
1/8W

CR30

⑨

R79
1.8K

-15V

Q20
663-00071

CR 22
376-00079

CR23
374-00025

Q19

C8
50Pf

C9
500Pf

C10
33Pf

R61
1K

-15V

R62
3K

R63
3K

R57
91

-15V

R136
1.5K

F

EXT.

MHz

KHz

500
10
30
300
100
150
300
KHz
75
1
30
3
10
MHz

-.5V

SECTION 3
S207
(TYP.)

ITEM NO.	PART NO.	DESCRIPTION	QTY

MATERIAL LIST

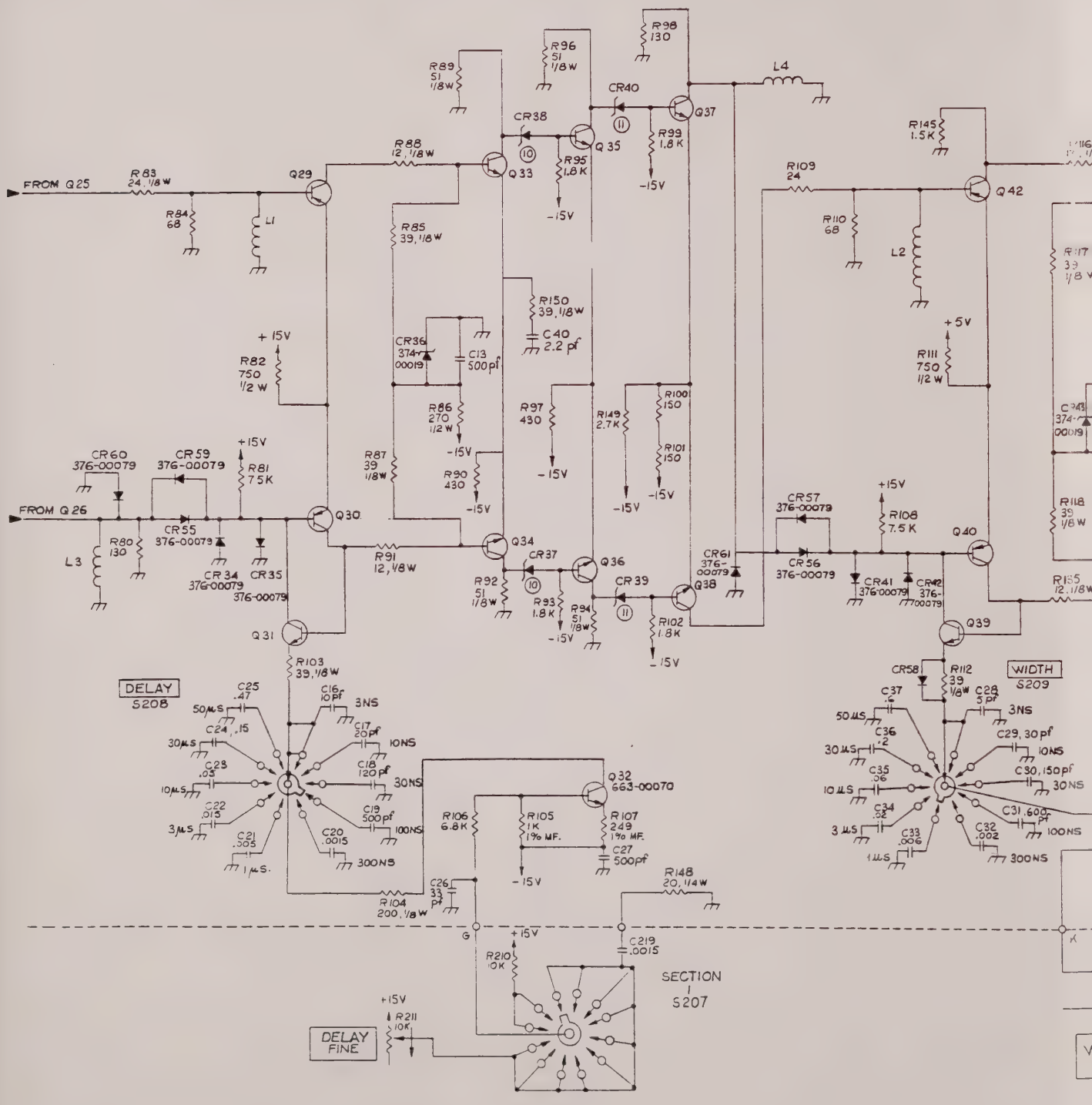
UNLESS OTHERWISE SPECIFIED
SCALE:
FRACTIONAL ± 1/64
DECIMALS: .XX ± .03
.XXX ± .010
ANGLES: ± 1°
DO NOT SCALE DRAWING
FINISH

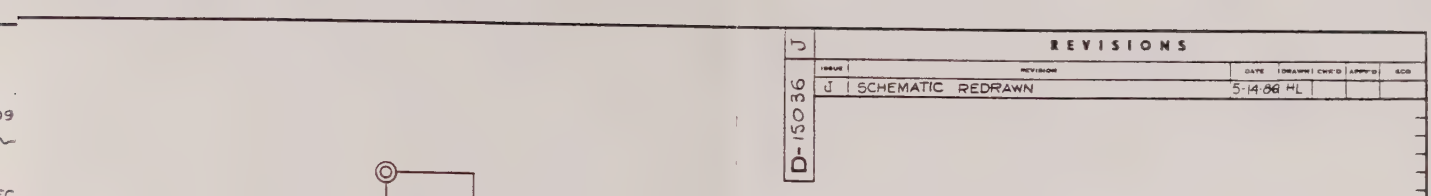
ELECTRONICS
FREMONT, CA

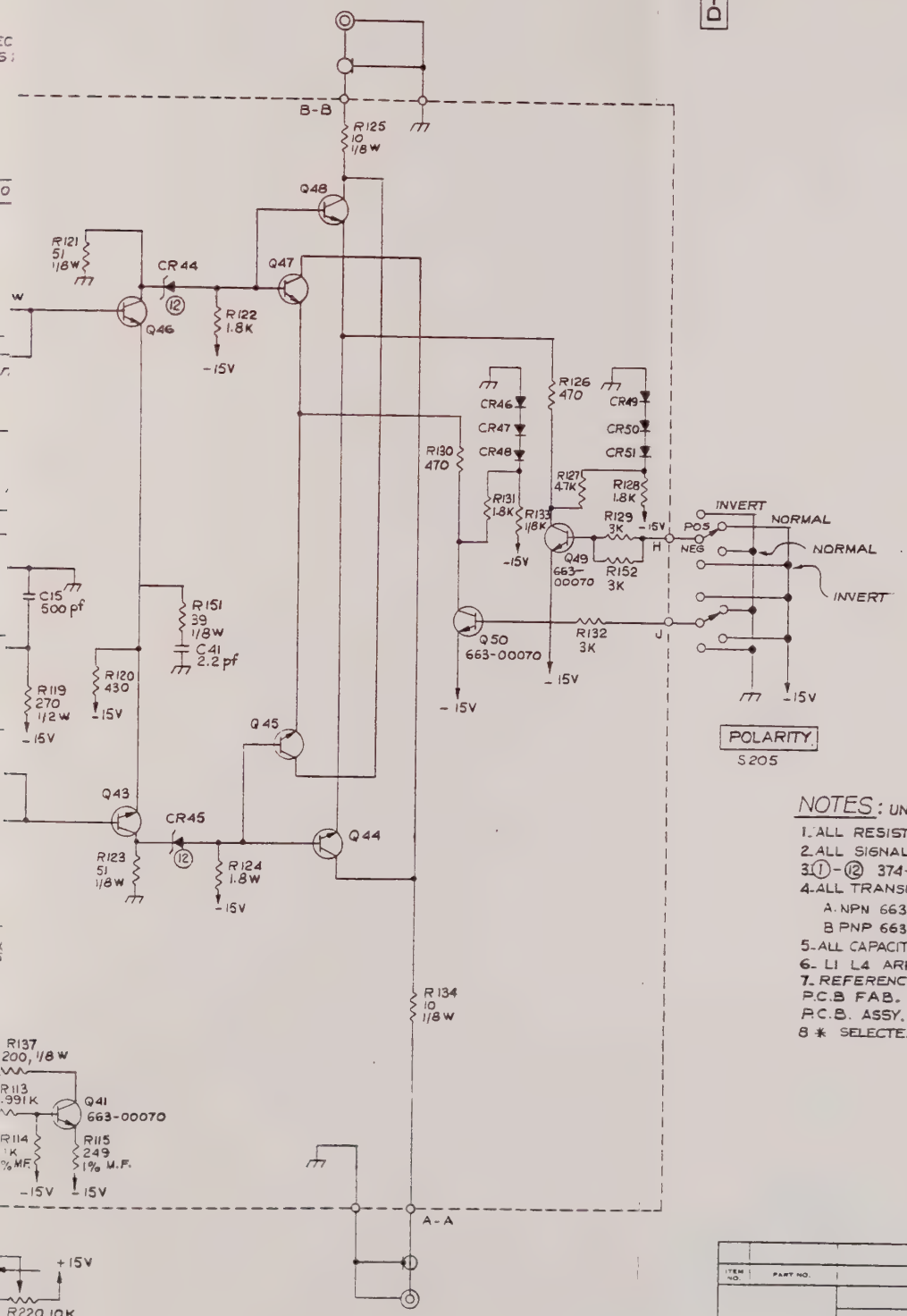
TITLE
SCHEMATIC P.C.B.
TIMING BOARD

	INITIALS	DATE	MODEL 129
DRAWN	HL	5-21-86	D- 140 15036 J
CHK'D			
APP'D			SHEET NO. 1 OF 2 SHEETS

NEXT ASSY
USED ON


FROM Q25
R83 24, 1/8W
Q29
R84 68
L1
R88 12, 1/8W
Q33
R89 51 1/8W
R96 51 1/8W
R98 130
CR40
CR38
Q35
R95 1.8K
R99 1.8K
-15V
Q37
L4
R85 39, 1/8W
R150 39, 1/8W
C40 2.2 pf
CR36 374-00019
C13 500 pf
+15V
R82 750 1/2 W
R86 270 1/2W
R97 430
R149 2.7K
R100 150
R101 150
R87 39 1/8W
R90 430
CR60 376-00079
CR59 376-00079
R81 7.5K
FROM Q26
Q30
L3
R80 130
CR55 376-00079
CR34 376-00079
CR35 376-00079
R91 12, 1/8W
Q34
CR37
Q36
R92 51 1/8W
R93 1.8K
R94 51 1/8W
CR39
Q38
R102 1.8K
Q31
R103 39, 1/8W
DELAY S208
C25 .47
C16 10pf
3NS
C24 .15
C17 20pf
10NS
C23 .03
C18 120pf
30NS
C22 .015
C19 500pf
100NS
C21 .005
C20 .0015
300NS
1 μS.
R104 200, 1/8W
C26 33 pf
Q32 663-00070
R106 6.8K
R105 1K 1% MF.
R107 249 1% MF.
C27 500pf
-15V
R148 20, 1/4W
G
+15V
R210 10K
C219 .0015
SECTION I S207
+15V
R211 10K
DELAY FINE
R109 24
Q42
R110 68
L2
R145 1.5K
+5V
R111 750 1/2 W
CR57 376-00079
CR56 376-00079
+15V
R108 7.5K
Q40
CR61 376-00079
CR41 376-00079
CR42 376-00079
Q39
CR58
R112 39 1/8W
WIDTH S209
C37
C28 5 pf
3NS
50 μS
C36 .2
C29, 30 pf
10NS
30 μS
C35 .06
C30, 150 pf
30NS
10 μS
C34 .02
C31, 600 pf
100NS
3 μS
C33 .006
C32 .002
300NS
1 μS
K





NOTES: UNLESS OTHERWISE NOTED

1. ALL RESISTORS IN OHMS, 1/4 W, 5%.
2. ALL SIGNAL DIODES ARE 376-11764.
3. (1)-(12) 374-11761 MATCHED PAIR.
4. ALL TRANSISTORS ARE:
   A. NPN 663-19245.
   B PNP 663-12528.
5. ALL CAPACITORS IN μf, 10%.
6. L1 L4 ARE 1 1/2" NO.24 BUS WIRE.
7. REFERENCE DRAWINGS.
   P.C.B FAB. 400-15034.
   P.C.B. ASSY. 402-15035
8. * SELECTED VALUE (FACTORY SELECT)

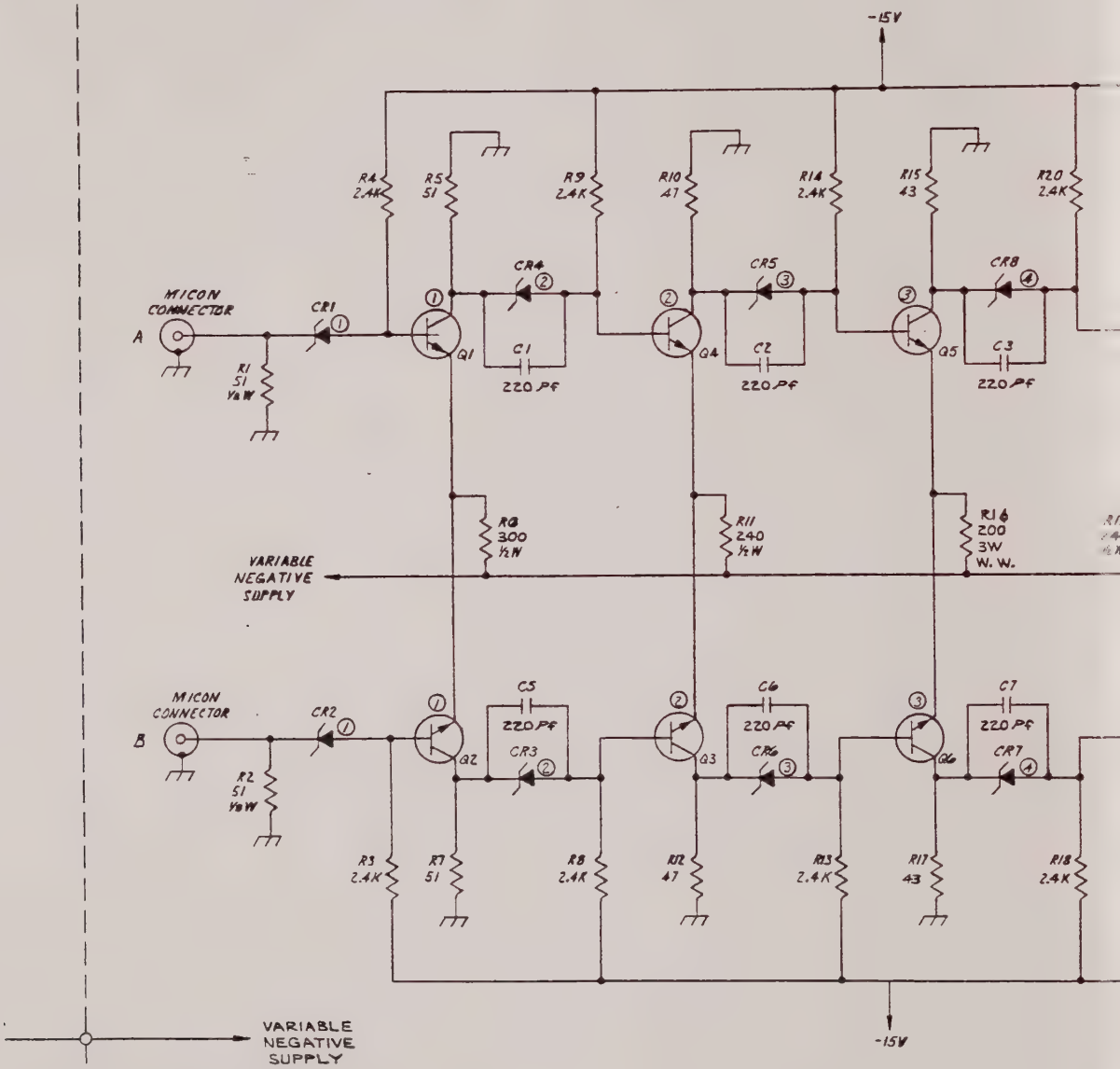
MATERIAL LIST

ELECTRONICS FREMONT, CA

SCHEMATIC P.C.B. TIMING BOARD

D-15036 J

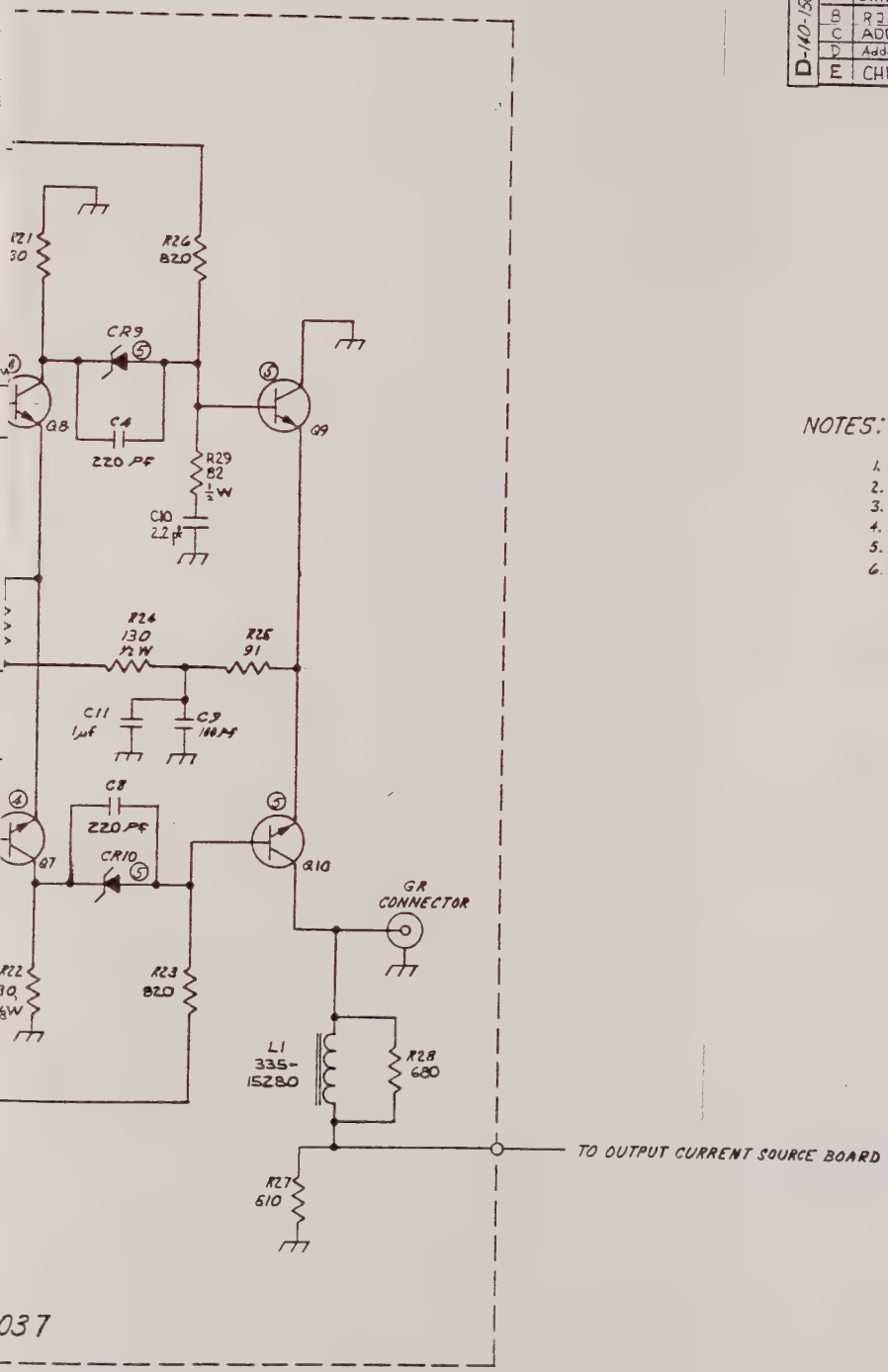
SHEET NO 2 OF 2 SHEETS


-15V
R4 2.4K
R5 51
R9 2.4K
R10 47
R14 2.4K
R15 43
R20 2.4K
CR4
CR5
CR8
MICON CONNECTOR
A
CR1
Q1
Q4
Q5
C1 220 PF
C2 220 PF
C3 220 PF
R1 51 ½W
R8 300 ½W
R11 240 ½W
R16 200 3W W. W.
VARIABLE NEGATIVE SUPPLY
MICON CONNECTOR
B
CR2
Q2
Q3
Q6
C5 220 PF
C6 220 PF
C7 220 PF
CR3
CR6
CR7
R2 51 ½W
R3 2.4K
R7 51
R8 2.4K
R12 47
R13 2.4K
R17 43
R18 2.4K
-15V
VARIABLE NEGATIVE SUPPLY
-15V

P.C.B. 400-

REVISIONS						
A	ORIGINAL RELEASE					
B	R28 WAS 510 Ω ½W, R24 WAS 120 Ω	7-30-69	DS	GAG		DEN
C	ADDED R29 & C10 ZR22 ½W	10-6-69	RTS			
D	Added C11, 1 mf	1-19-70	GA			
E	CHNG VALUE OF R28	19 OCT 1985				85-155

D-140-15039 E



037

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. CIRCLED NUMBERS INDICATE MATCHED PAIRS.
2. ALL DIODES ARE MATCHED PAIRS: 374-11797
3. ALL TRANSISTORS ARE MATCHED PAIRS 663-15300
4. ALL RESISTORS ARE IN Ω (OHMS) ¼ W 5% CARBON.
5. ALL CAPACITORS ARE IN PF (PICO-FARADS), AND HAVE FOIL LEADS
6. REFERENCE DRAWINGS:
   P.C.B. FAB 400-15037
   P.C.B. ASSY 402-15038

ITEM NO. | PART NO. | DESCRIPTION | QTY

MATERIAL LIST

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING

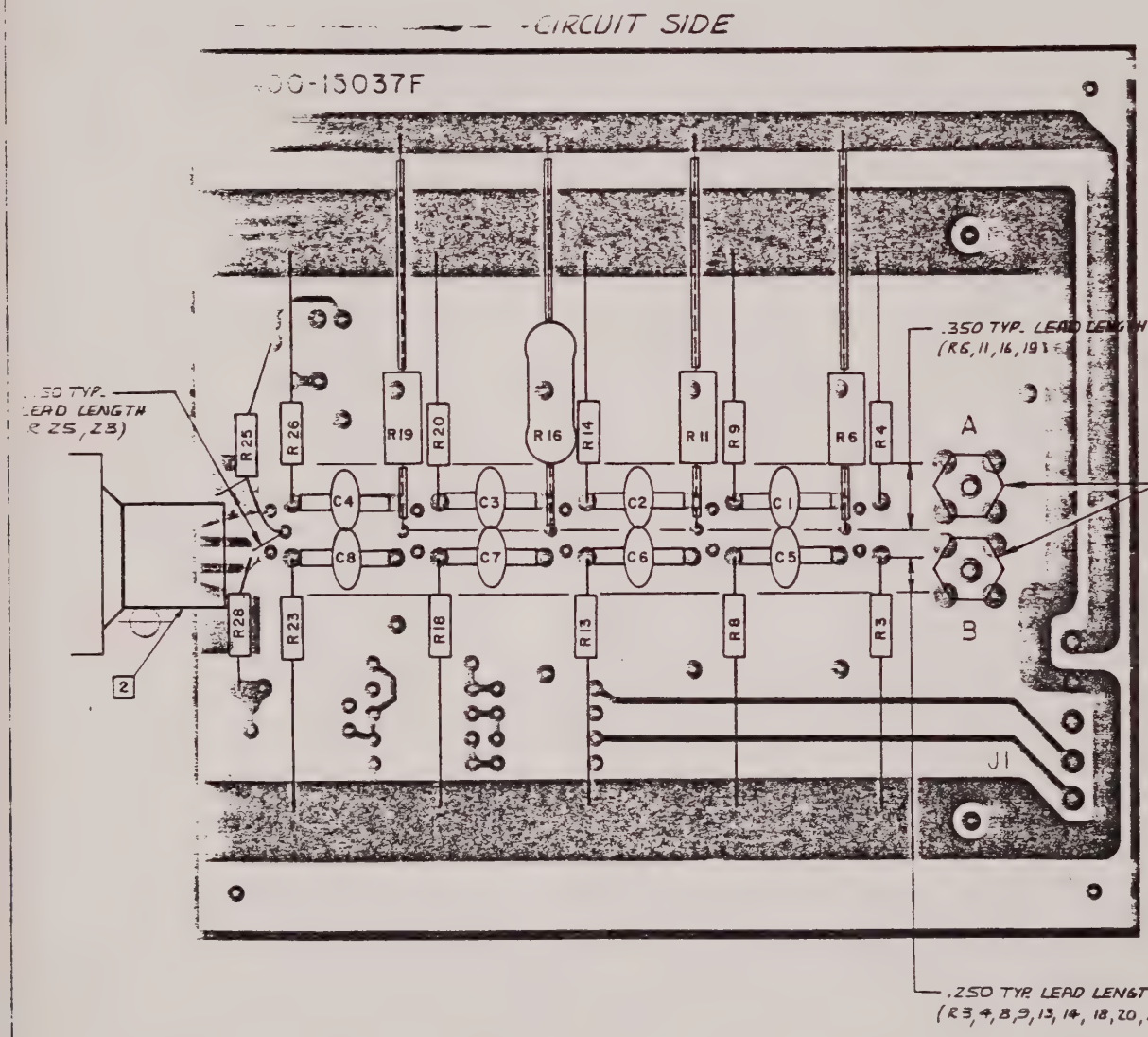
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE:
SCHEMATIC
OUTPUT BOARD

402-5023 | NEXT ASSY
— | USED ON
12 P

129

		4/12/68	D-140-15000 E
	GAG	6-2-69	

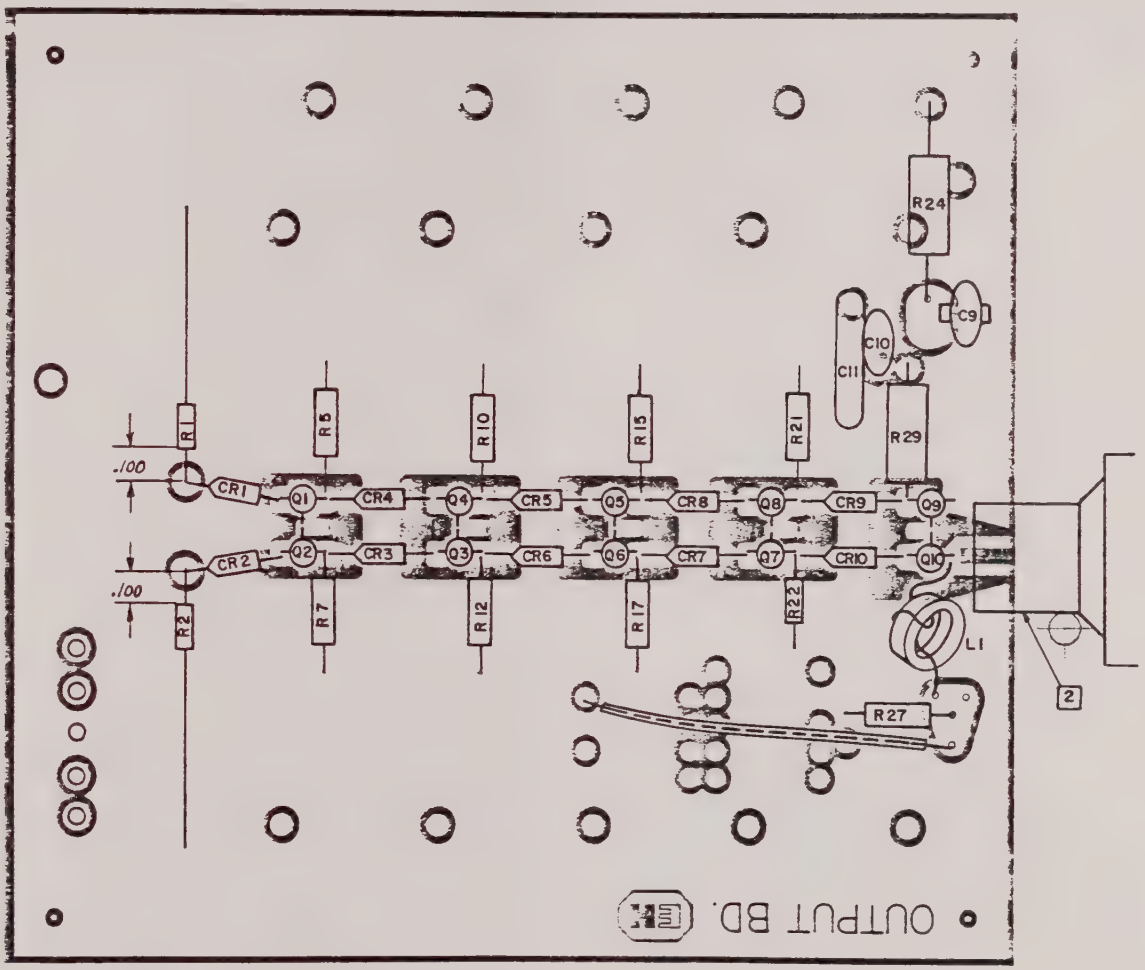


NOTES :

1. WHITE SIDE TO FACE UP ON
   BLACK SIDE TO FACE UP ON
2. SEE GR. CONN. ASSY PROCEDU
3. ON LEADS OF R6 11 16 & 19
4. REF DWG.
   FAB. DWG. 400-15037
   SCHEMATIC: 100-15039

REVISIONS						
A	ORIGINAL ISSUE	—	—	—	—	
B	BM CHANGE	15 OCT 1985	[illegible]			85-135

COMPONENT SIDE



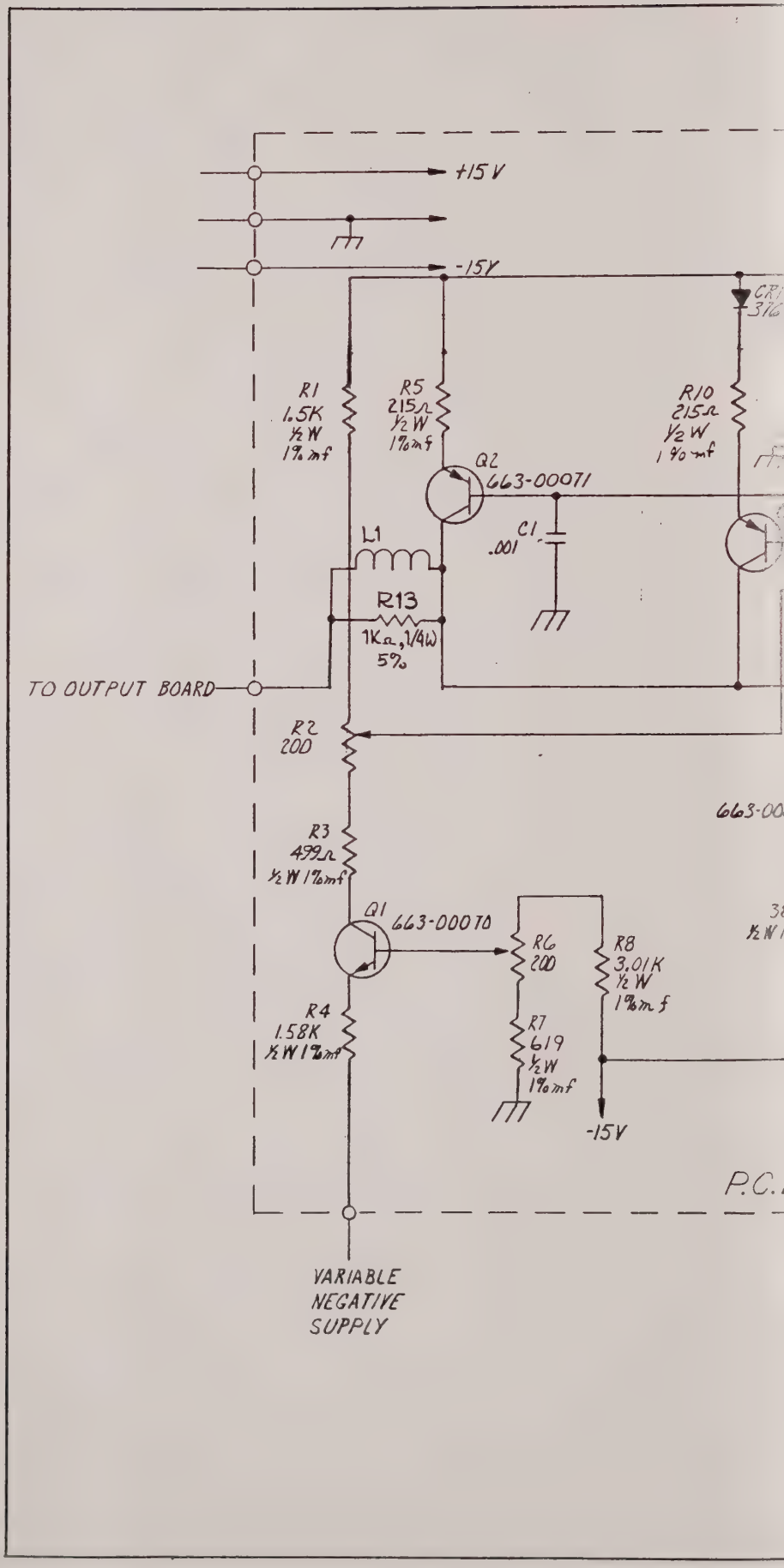
2,3,6,7,10
,4,5,8,9
: 721-15729
CLEAR VINYL SLEEVING.

ITEM NO.	PART NO.	DESCRIPTION	QTY
		MATERIAL LIST	

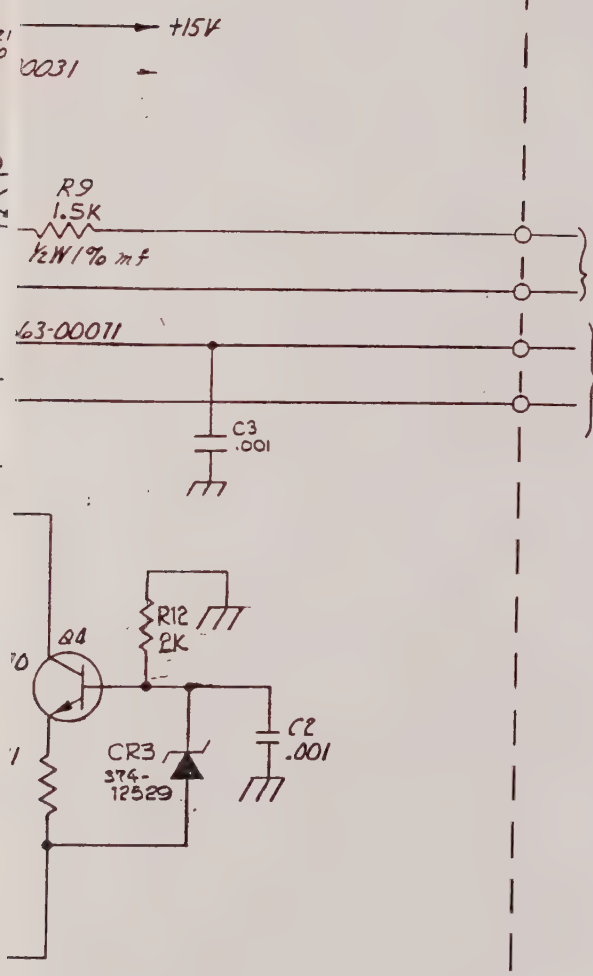
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE:
ASSY DWG.
OUTPUT BD.

	ST	2-77	129
			402-15038 B


+15 V
-15V
R1
1.5K
½W
1%mf
R5
215Ω
½W
1%mf
R10
215Ω
½W
1%mf
Q2
663-00071
C1
.001
L1
R13
1KΩ, 1/4W
5%
TO OUTPUT BOARD
R2
200
R3
499Ω
½W 1%mf
Q1
663-00070
R6
200
R8
3.01K
½W
1%mf
R4
1.58K
½W 1%mf
R7
619
½W
1%mf
-15V
VARIABLE
NEGATIVE
SUPPLY

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	ECO
A	ORIGINAL RELEASE	—	—	—	—	—
B	R7 WAS 665 Ω	7-30-69	DS	GAG	[illegible]	DCN 44
C	ADDED C3	10-6-69	RTS	[illegible]	[illegible]	DCN 4
D	ADDED L1 & R13, REVERSED R12 & CR3	15 OCT 1985	[illegible]			85-155



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. RESISTORS ARE IN Ω (OHMS) ¼ W 5% CARBON UNLESS OTHERWISE SPECIFIED.
2. CAPACITORS ARE IN μf (MICRO FARADS)
3. REF. DWGS.
   P.C.B. FAB 400-15031
   P.C.B. ASSY 401-15032

C-140-15033 D

ITEM NO.	PART NO.	DESCRIPTION	QTY

MATERIAL LIST

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

NEXT ASSY | REQ'D | USED ON 129

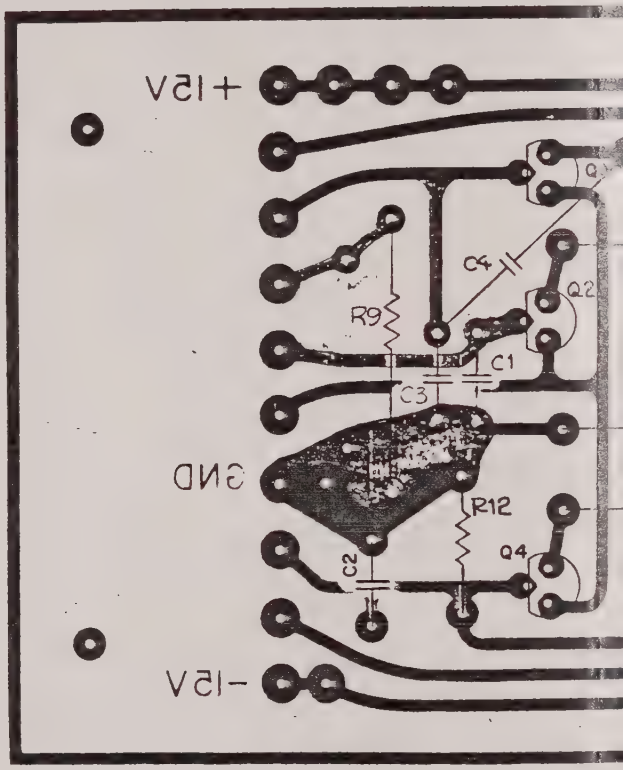
UNLESS OTHERWISE SPECIFIED
SCALE:
FRACTIONAL ± 1/64
DECIMALS: ± .XX = 03
± .XXX = 010
ANGLES: ± 1°
DO NOT SCALE DRAWING
FINISH:

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE:
SCHEMATIC
OUTPUT CURRENT SOURCE
BOARD

	INITIALS	DATE
DRAWN	LARRY	2/3/69
CHK'D	GNG	6-2-69
APP'D		

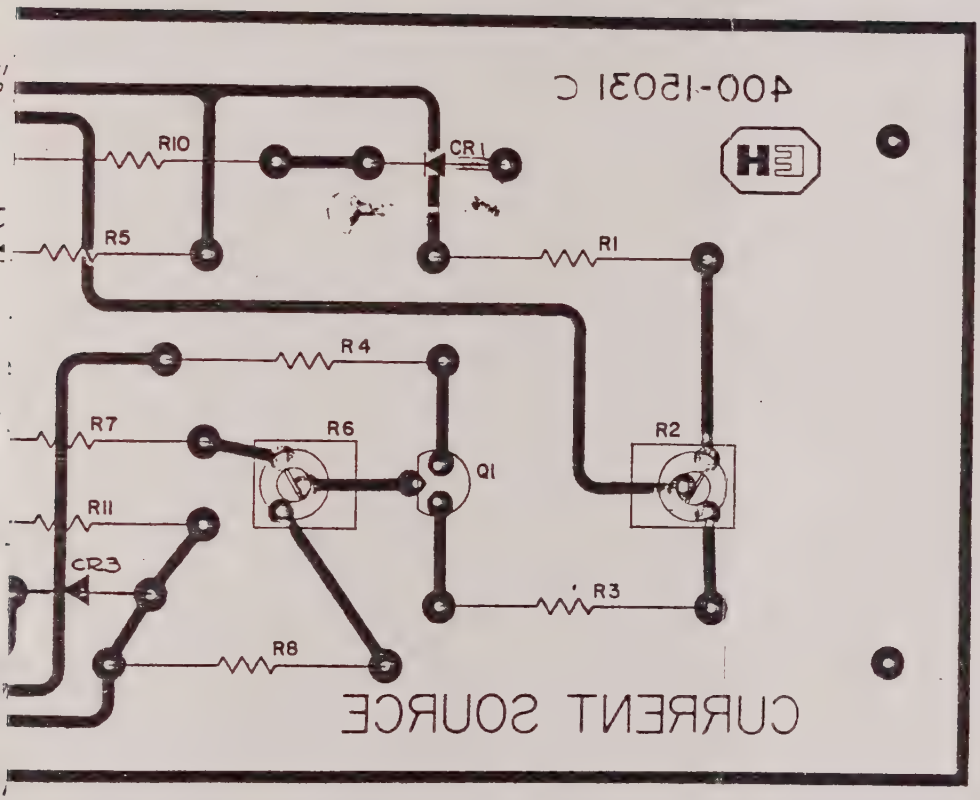
MODEL 129
C-140-15033 ISSUE D
SHEET NO 1 OF 1 SHEETS



REF. DWG'S

1	BOARD OUTLINE	C-13399
2	FAB (SPEC) DWG	C-400-15031
3	ASSEMBLY DWG	C-401-15032
4	SCHEMATIC DWG	C 140-15033

ISSUE	REVISION
A	ORIGINAL RELEASE
B	
C	ADDED: C3; REMOVE:
D	ADDED SHT 2, Reverse CR3



REVISIONS					
	DATE DRAWN	CHK'D	APPV'D	E.O.
	— —	—	—	—
R2;	4/12/72 C.A.D.			ECN 28
12 Positions, AND C4	15 OCT 1985			85-155

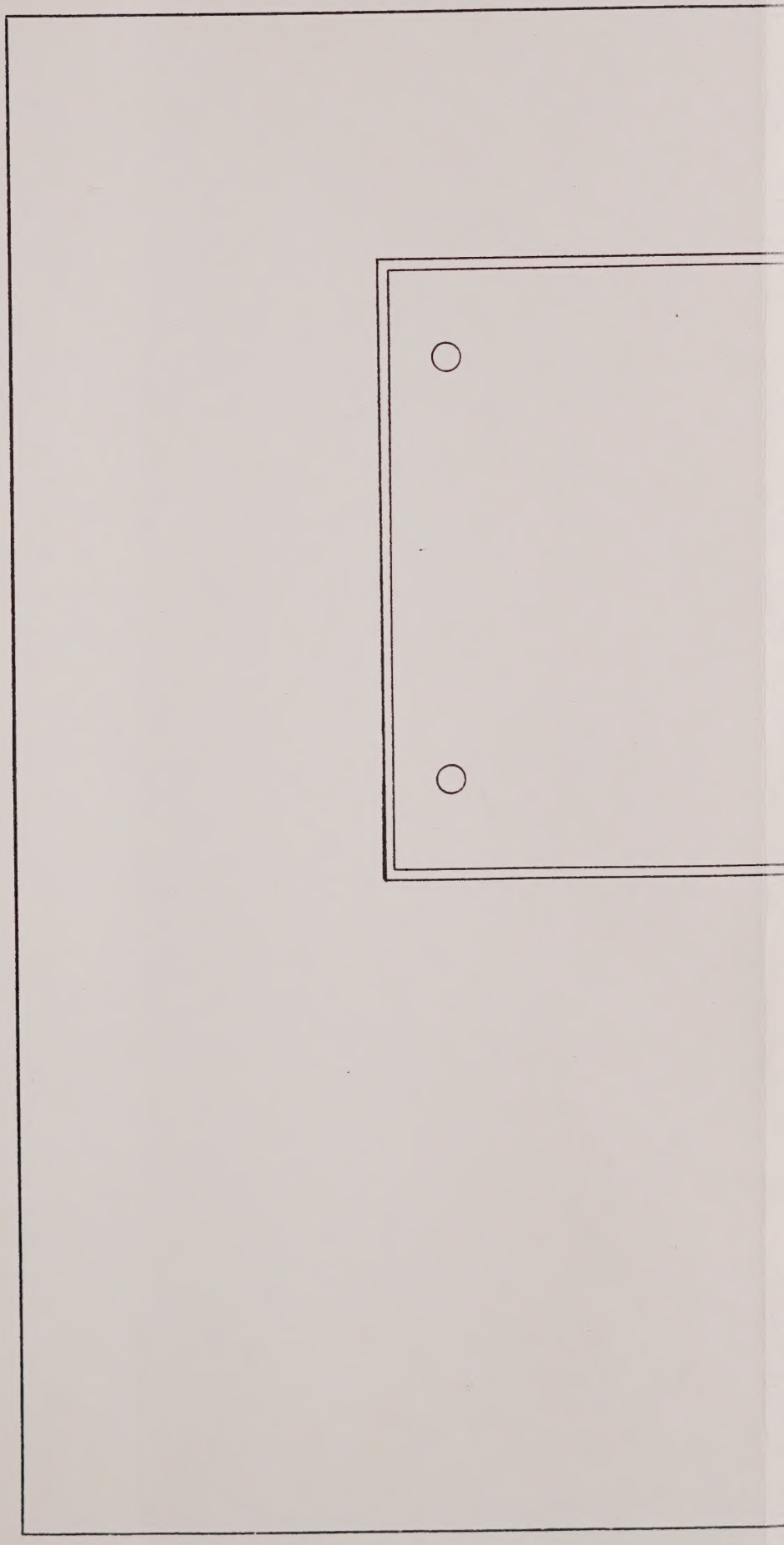
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

129	1		
USED ON	REQ'D	NEXT ASSY	

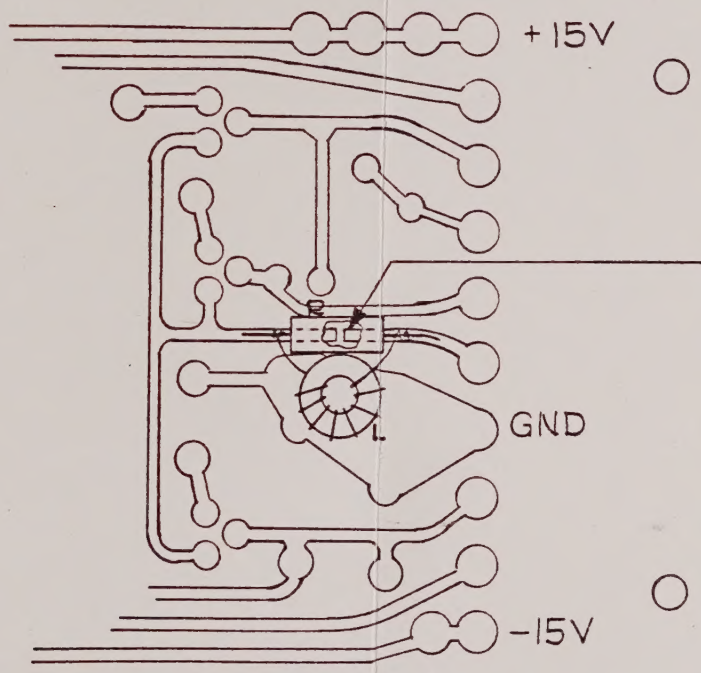
PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

ASSEMBLY DRAWING
CURRENT SOURCE

	NAME	DATE	MODEL 129	
DRAWN	C.A.D.	4-17-69	401-C-15032	ISSUE D
CHK'D	J.C.	21 Apr 69		
APP'D			SHEET NO. 1 OF 2	



REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	ECO
	SEE SHT 1	19 OCT 1985				



C-15032

ITEM NO.	PART NO.	DESCRIPTION	QTY

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE:
FRACTIONAL ± 1/64
DECIMALS: ± .XX = .03
± .XXX = .010
ANGLES: ± 1°
DO NOT SCALE DRAWING
FINISH:

NEXT ASS'Y | REQ'D | USED ON

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE:
ASSEMBLY DWG
CURRENT SOURCE

	INITIALS	DATE
DRAWN		19 OCT 1985
CHK'D		
APP'D		

MODEL 129
401-C-15032
ISSUE
SHEET NO. 2 OF 2 SHEETS

CSL